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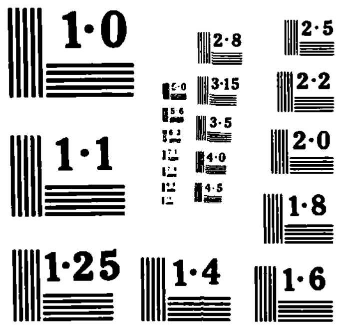

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AD-A156 312

SCN: 70-80-04

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION STUDY

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QUANTICO, VIRGINIA 22134-5080

AUGUST 27, 1982

FINAL REPORT, VOLUME I

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COMMANDANT OF THE MARINE CORPS
CODE RD
HEADQUARTERS, U. S. MARINE CORPS
WASHINGTON, D. C. 20380

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DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
WASHINGTON, D.C. 20380

IN REPLY REFER TO
POG-31
3400
14 MAR 1985

From: Commandant of the Marine Corps

Subj: MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION STUDY

1. The objectives of the study were:

a. Determine the levels of chemical contamination within which Marine Air-Ground Task Force (MAGTF) units may be required to operate.

b. Identify specific material requirements and procedures for vehicles, aircraft, and personnel decontamination.

c. Identify collective protection requirements, types of collective protection, and procedures for Marine Corps units in a combat environment. This will include air and ground combat units, combat support, and combat service support in an amphibious environment.

d. Describe a handling and movement system for NBC casualties.

e. Review and analyze the Dugway Proving Grounds report titled Effects of Chemical Attacks on Tactical Staging Operations. Identify the critical assumptions in the Dugway report, and compare their implications with those assumptions being used in this study.

f. Determine where the new data might have an impact on NBC doctrine, and make alternative recommendations to modify that doctrine.

2. The Marine Corps Requirements and Procedures for Decontamination and Collective Protection Study accomplished its stated objectives.

3. Those study recommendations which deal with personnel and equipment reorganization are not concurred in. They have been invalidated by the failure of key developmental decontamination equipment projects since the end of the study effort. The remaining recommendations are concurred in subject to the following comments.

a. Any new initiatives in support of this study will compete on an equal basis in the POM development process.

b. The following requirements have arisen since the completion of the study, and should be considered in the development of any

unlimited.

Encl (2)

Subj: MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION STUDY

Marine Corps program for decontamination and/or collective protection.

(1) Electronic Equipment. Electronic equipment is increasingly used by the Fleet Marine Force. A decontamination agent is needed which will not damage electronic equipment. It should be noncorrosive and quick acting.

(2) Shelterized Electronic Equipment. A collective protection system or systems is needed to support the growing family of shelterized electronic equipment, such as the Tactical Air Operations Module (TAOM), the Marine Integrated Fire and Air Support System (MIFASS), and the Position Location and Reporting System (PLRS).

c. The intelligence assessment in the study is dated. Current intelligence information must be considered in development of a decontamination and collective protection program based on this study.

4. A copy of this letter will be affixed inside the cover of each copy of the subject study report prior to distribution.

RAY "M" FRANKLIN
Major General U.S. Marine Corps
Deputy Chief of Staff for RD&S

Distribution:

DTIC	(2)
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Blood Agents
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CP Equipment (CPE)
Chemical Warfare (CW)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report is the third in a series of three done for the Marine Corps which supplements the previous two entitled: (1) Nuclear, Biological, and Chemical Defense (NBCD) Readiness in the Mid-Range Period (1978-1990) and (2) Concept of Operations for NBC Defense in the Mid-Range. This report provides details for collective protection, decontamination, and NBC casulties. Specifically, this report provides the following in-depth information: (1) determination of levels of chemical contamination within which MAGTF units may be required to operate using the projected midrange inventory, (2) identification of specific material

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19. (Continued)

Chemical Contamination Levels
Decontamination
Gas Particulate Filter Unit (GPFU)
Integrated Battlefield
Mission Accomplishment with Dynamic Survivabilty (MADS)
Mission-Oriented Protective Posture (MOPP)
Modular CPE (MCPE)
Non-Persistent
Combat Assessment Techniques (CAT)
Nuclear, Biological, and Chemical (NBC)
NBC Casualties
NBC Defense (NBCD)
Persistent (P)
Simplified CPE (SCPE)
Survive to Operate (STO)
Triage
Vesicants
Nerve Agents

20. (Continued)

requirements and procedures for vehicles, aircraft, and personnel decontamination, (3) identification of collective protection (CP) requirements, types of CP, and CP procedures for Marine Corps in a combat environment (includes air and ground combat-maneuver units, combat support, and combat service support in an amphibious operation), (4) description of a handling and movement system for NBC casualties, (5) a review and analysis of a Dugway Proving Ground draft report titled "Effects of Chemical Attacks on Tactical Staging Operations, December 1980", (6) identification of critical assumptions made in the Dugway report and comparison of their implications with current NBCD data used in the Marine Corps study, and (7) determination of where the Dugway data might impact on present NBCD doctrine and of alternative recommendations which could modify present doctrine.

Letter on file

Dist A

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 Purpose. This study provides a detailed analysis of the Marine Corps requirements for decontamination, collective protection, and casualty handling in a nuclear, biological, and chemical (NBC) threat environment. The study further recommends an improved system for the Marine Air-Ground Task Force (MAGTF) to accomplish decontamination, collective protection, and casualty handling during amphibious operations.

1.2 Approach and analysis.

The initial step for this study was acquisition, classification, and tabulation of data. This data base, which focuses on the most current available information on decontamination, collective protection, and NBC casualty-handling equipment and procedures was developed by pragmatic and experiential assessment of relevant literature and information obtained from fact-finding visits.

The next step in the study was determination of levels of chemical contamination in which a MAGTF will be required to operate. A continuing tactical situation within which NBC weapons are employed was developed in order to generate a realistic representation of continuing and repetitive contamination, its spread, and decay. The principal analytical tool used to assess the expected combat environment was a kinematic analysis using the combat assessment technique (CAT) developed for the "Concept of Operations for NBC Defense in the Mid-Range" study. The CAT involves systematic, computer-assisted, manual war gaming based on situations postulated in the modified MARCORS-1A scenario[1] to develop realistic combat engagements

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[1] Marine Corps Midrange Threat Scenarios and Target Lists Study (Phase II), MARCORS-1A, Marine Corps Development and Education Command, Quantico, Virginia, June 1980. SECRET.

and quantify the effects on battle results of changing selected independent variables.

The results of the projection of chemical agent density and cloud drift, including dissapation and combination of agent effects, creates, over time, an extensive threat to wide areas of the FBHA, according to current theories. Shifting wind patterns, typical of littoral regions, and repetitive chemical strikes create growing areas of liquid contamination, and nearly complete coverage of at least low levels of vapor contamination. The results presented in Volume II (Classified) graphically illustrate what the environment of an amphibious operation against chemical weapons might be like. This description of the battlefield was utilized in establishing a decontamination system that identifies the requirements and procedures for a MAGTF in an NBC environment.

The next step in the study was development of a collective-protection system based on the CAT description of the integrated battlefield and the ensuing recommended decontamination system. The collective-protection system considered the four types of collective protectors:

- Combat-vehicle systems.
- Simplified collectve-protection systems.
- Modular collective protection.
- Special collective protection.

As the final step, the output from the CAT described previously, the location, level, and frequency of contamination on the battlefield was used by the study team as a base for experiential assessment and deductive reasoning to estimate the number and distribution of resulting conventional, chemical, and conventional-plus-chemical casualties. The study team examined the impact of these types of casualties on the current casualty-

handling system. Included in this analysis was an estimate of handling/treatment times, the identification of special skills/occupations, the identification of additional equipments and facilities. The results of this analysis provided the basis for deductions of additional resources required to effectively handle NBC casualties during amphibious operations.

Finally, an additional requirement was defined by the study sponsor: The review of data obtained from the U.S. Army Dugway Proving Grounds, Utah, which appeared to have a significant impact on the CAT war game simulations. Specifically, the current "accepted standards" for chemical agent contamination decay, for different meteorological conditions, are significantly different from the standards postulated in the Dugway information. The study sponsor directed that the Dugway information be evaluated to determine how significantly it impacted on the original study objectives, and on the doctrine developed in previous NBCD studies.

1.3 NBC threat update.

The NBC threat data used for this study was extracted from the "Concept of Operations for NBC Defense in the Midrange" study[2] as approved by the study sponsor. Specific agent weapon data from this report was used in the CAT analysis and is presented in Volume II of this study.

During the time frame of conduct of this study, there has developed a broader sense of awareness of the Soviet chemical and biological warfare capability. An indication of this general awareness is the reporting of events in Afghanistan (suspected use of chemical agents) during 1980 by

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[2] Concept of Operations for NBC Defense in the Mid-Range, Marine Corps Development and Education Command, Quantico, Virginia, June 1981. SECRET.

such media as Time Magazine, New York Times, U.S. News and World Report, Washington Post, and numerous television networks.

The most recent (and most disturbing) information on the probable use of mycotoxins in Southeast Asia further points to the awesome NBC capability of the Soviet Union. While mycotoxins are not considered a traditional chemical warfare agent, they have many similar tactical applications and provide another indication of the acceptance of this type of combat use of NBC agents by the Soviet planners. A recent editorial in the Wall Street Journal sums it up as follows:

> "Except to the willingly obtuse, the evidence is conclusive. The Soviets have long been engaged in the development and production of chemical and biological weapons. They have used these warfare agents in Yemen in the 1960s and now in Cambodia, Laos, and Afghanistan. In addition to its intrinsic brutality, this kind of warfare amounts to a calculated and massive violation of international arms control agreements."

1.4 Decontamination.

When viewed against the background of the recognized NBC threat potential for contamination, the FMF decontamination capability was evaluated at best marginal. The most serious problem was the lack of a comprehensive decontamination doctrine specifically oriented toward the FMF and amphibious operations. While some of the decontamination equipment was adequate (mostly the individual kits), much of it was ageing, available in inadequate numbers, and authorized at the wrong level in the organization.

The study team reviewed the decontamination equipment and doctrine, and equipment of the other US Services and that of the NATO nations, and other selected allies. With this data base, the team developed a decontamination system for the FMF which is based on the following considerations:

- The risk of taking casualties if decontamination is not done.
- Time and resources required in the decontamination effort.
- The capability of the unit or individual to perform decontamination.
- The impact of decontamination on the mission.

The system has been developed to meet the proposed threat and be integrated into the FMF amphibious operations. This system, which is discussed in Chapter 2, is summarized on table 1. The recommendations to support this system are presented in Chapter 6.

1.5 Collective protection.

The threat of attack by NBC weapons will require the MAGTF to assume an NBC defensive posture during the conduct of amphibious operations. The individual NBC protective ensemble which the Marine must use for protection against this NBC threat imposes severe limitations on his mobility, stamina, and combat capability. The prolonged wear of the ensemble may cause excessive heat casualties during operations. In order to continue sustained operations on the integrated battlefield, there is a need for some form of collective protective (CP). The MAGTF NBC defensive posture will require the utilization of CP equipment (CPE) in shelters, buildings, temporary structures, and selected combat vehicles as well as provision of overhead protection of equipment, supplies, and personnel from liquid agent attacks. CPE will be required for those units that must remain in contaminated areas, and in those fixed installations such as airfields and logistical support areas which are prime targets for persistent chemical agents.

Table 1. The MAGTF Decontamination System

	INDIVIDUAL	CO/BTRY	BN/SQDN	MAU	REGT/GRP	MAB	DIVISION	WING	FSSG	MAF
LEVEL OF DECON	Emergency	Limited/ Partial	Limited/ Partial/ Complete*	Limited/ Partial/ Complete*	Limited/ Partial/ Complete*	Complete	Complete	Complete	Complete	Complete
TYPE OF DECON	Individual, Personal Weapons, Clothing and Equipment	Unit mission Essential Equipment	Unit mission Essential Equipment	Unit mission Essential Equipment	Unit mission Essential Equipment	Complete	Complete	Complete	Complete	Complete
CURRENT EQUIPMENT	M13 M258	M13 M11	M13 M11 M12A1	M13 M11 M12A1	M13 M11 M12A1	M13 M11 M12A1	M12A1	M12A1	M12A1	M12A1
CURRENT REQUIREMENTS	1 per individual	M13-1 per individual M11-1 per wpn/vehicle	M13-1 per individual M11-1 per wpn/vehicle	M13-1 per individual M11-1 per wpn/vehicle	M13-1 per individual M11-1 per wpn/vehicle	M12A1-1 per bn	M12A1-1 per bn	M12A1-1 per sqdn	M12A1-1 per bn	M12A1-1 per bn
CURRENT PERSONNEL	Individual responsibility	Crew responsibility	Crew responsibility. Additional duty	Additional duty	Additional duty	Additional duty	NBCD unit assigned	NBCD unit assigned	NBCD unit assigned	NBCD unit assigned from subordinate commands
CURRENT PROCEDURES	Scrape/ blot/dust	Dust/wash/ scrub/rinse	Dust/wash/ scrub/rinse	Dust/wash/ scrub/rinse	Dust/wash/ scrub/rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse
CURRENT DEFICIENCIES/ DEVELOPMENT REQUIREMENTS	Larger dusting mitts and towelletes, improved and decon solutions	Larger dusting mitts, portable decon system (capacity)	Dusting mitts, towelletes, portable decon, lightweight decon, universal decon agent, coating	Dusting mitts, towelletes, portable decon, lightweight decon, universal decon agent, coating	Dusting mitts towelletes, portable decon, lightweight decon, universal decon agent, mobile decon system	Mobile decon system, large area/ rapid decon system, universal decon agent, interior decon, coating	Mobile decon system, large area/ rapid decon system, interior decon, universal decon agent, coating, agent immobilization, clothing/ equipment decon	Same as Division	Same as Division	Same as Division
DEVELOPMENT EQUIPMENT	M258A1	XM13-portable decon, apparatus, 14 liter XM17, lightweight decon system	XM13, XM17, XM15 - interior surface decon, XM14 - vehicle mounted decon system, XM16-jet exhaust decon system	XM13, XM17, XM15, XM14, XM16	XM13, XM17, XM15, XM14, XM16	XM13, XM17, XM15, XM14, XM16, Personnel equipment decon system (PEDS shower/ laundry unit	XM13, XM17, XM15, XM14, XM16, PEDS, shower/ laundry	Same as Division	Same as Division	Same as Division
CONCEPTUAL EQUIPMENT						Thin-film flakes, sacrificial coating, corona discharge laser	Same as MAB	Same as MAB	Same as MAB	Same as MAB
RESEARCH AND DEVELOPMENT REQUIREMENTS	Improved dry decon capability, improved decon solutions	Improved dry decon capability, improved decon solutions	Improved dry decon capability, improved decon solutions	Decon monitor, dry decon, solutions, universal decon agent	Decon monitor, dry decon, solutions, universal decon	Decon monitor dry decon, solutions, universal decon agt	Same as MAB	Same as MAB	Same as MAB	Same as MAB
PERSONNEL REQUIREMENTS	No Additional	Personnel	Maintenance & Operator	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn

*Not routine operations but equipment available, if required.

The purpose of CP is to provide a protective environment in which (1) individuals can carry out tactical functions efficiently without the encumbrance of individual chemical and biological protective equipment; (2) individuals can find relief from wearing individual protective equipment, and can eat, sleep, and perform personal hygiene; and (3) a clean area is provided for key personnel in case of chemical attack. Typical tactical situations requiring CP are found in command posts, communications centers, fire-control stations, missile-control complexes, medical and hospital complexes, and rest-and-relief stations.

It may also be necessary to provide protection for certain tactical equipment. The complexity and possible vulnerability of electronic equipment may make the equipment itself the prime target of an attack. The potential corrosive action of smoke and other common agents, or the employment of antimaterial agents could render the equipment inoperable or cause it to malfunction.

The study team reviewed the current capabilities of the MAGTF to provide CP and found severe limitations in equipment and doctrine. After a comprehensive review of available CPE and various CP doctrine, a collective protection system has been developed to meet the needs of the MAGTF in an NBC threat environment. The recommended system is summarized on table 2. Specific details of the equipment, doctrine, and support resources required to implement this system are provided in Chapter 3.

1.6 <u>NBC casualty handling</u>.

The casualty handling system which will meet the challenge of the integrated battlefield must provide for the treatment and handling of NBC casualties as well as ensure effective medical support in a contaminated

Table 2. MAGTF Types of Protection

	MAGTF Elements				
MAGTF Collective Protection System	Combat units less vehicles	Combat support units	Combat vehicles	Combat service support	Air operations ashore
CP Requirements	Limited rest and relief.	Selected operations. Rest and relief.	Crew operations	Extensive rest and relief. Selected operations	Sustained base operations. Extensive rest and relief.
Type of CP	Small shelters	Small shelters	Ventilated facepiece. Overpressure.	Positive pressure. Shelters. Vans.	Positive pressure. Shelters. Vans.
Currently Authorized	None	M6A1 (selected units)	M8A3 (one per M48TK, M88, and M578) M13A1 (one per M60, M1, and LVTP7)	None	None
Recommended CPE (Current)	None	None	M14	M7A1	None
Recommended CPE (Developmental)	SCPE	SCPE	Hybrid	MCPE[1]. SCPE. MCESS MCECMS	SCPE. MCESS modification. MCPE[1]
Recommended CPE (Conceptual)	None	None	None	PECPS	PECPS
R and D Requirements	Shelter monitor/detector.	Shelter monitor/detector.	Individual CB protection suit.	Shelter monitor/detector.	Shelter monitor/detector.
Personnel Requirements[2]	No additional personnel				

[1]MCPE for appropriate vans/shelters.
[2]Personnel will require additional limited training, of unit NBCD teams/personnel.

environment. In developing the system, the fundamental consideration is: "What is it that determines the medical workload level to be used as a system design criterion?"

Based on our analysis and various historical examples, the following factors define the design point selected for the proposed medical support system for NBC casualty handling in the MAGTF:

- Maximum sustainability casualty rate for assault waves (regiment-sized units) can run as high as 25 percent on D-day or D+1.
- Maximum sustainable casualty rate for division-sized units conducting an amphibious assault is 5 to 10 percent per day over a several-day period.
- Patients resulting from these casualty rates should occur at an expected casualty treatment ratio for conventional weapons of approximately 4:1.

Mass casualty situations, which may result either from conventional or NBC weapons use, are by definition not sustainable and may result in mission failure. Therefore, they should not be used as design conditions for medical support.

The current medical support for the MAGTF is unable to provide an adequate NBC casualty-handling capability. It is not equipped nor trained to conduct medical operations in a contaminated environment. In the development of a satisfactory NBC casualty-handling system, certain principles were identified which, while not a functioning element of the medical support system, to a great extent, will determine its success or failure in an NBC environment. These principles are summarized as follows.

- The individual NBC protective ensemble provides the Marine his best chance of survival in an NBC environment, whether or not he is a casualty. Every effort must be made to insure the integrity of the NBC protective ensemble is maintained until such time as the individual (casualty or not) is in an NBC-agent-free environment.
- Complete decontamination of personnel is a time and manpower intensive effort. Therefore, it should be accomplished as far from the FBHL as the situation permits and then only when decontaminated personnel are assured access to an NBC-agent-free environment. This applies, as well, to patients in the medical system.
- The buddy-aid system provides an important adjunct to medical support system and maximum use of this capability must be encouraged. However, buddy aid must be limited only to emergency short term actions that will not substantially degrade the Marines' mission performance.
- Many NBC contaminants are pervasive in nature and difficult to detect. Therefore, personnel and equipment must be determined to be contamination free before entry is permitted into a contamination-free facility.

Finally, in considering the requirement for the NBC casualty-handling system, the following goals are proffered:

- Utilize critical medical personnel at their highest level of capability.
- Minimize the injuries resulting from NBC agents while at the same time preventing the aggravation of conventional injuries.

- Protect patients and the personnel handling contaminated casualties or working in contaminated areas from further spread of contamination or toxic vapors.
- Avoid the spread of contamination into treatment facilities.
- Continue essential medical services to the maximum level possible in an NBC environment.

Keeping in mind all these factors, the study team developed a recommended system concept for NBC casualty handling in the MAGTF. This system is summarized in table 3.

1.7 NBCD doctrine and concepts review.

During the conduct of the data collection effort, the study team became aware of a significant report dealing with CW contamination. This report, "Effects of Chemical Attack on Tactical Staging Operations," was published in draft form by Dugway Proving Grounds, Utah, in December 1980 and is referred to throughout this report as the "Dugway report" or "Dugway data." The report presented a new method of calculations for CW agent evaporation and CW agent cloud travel and duration. This new method was a significant break with traditional methodology like that incorporated in FMFM 11-3, Employment of Chemical Agents.

At the request of the SAC and with the concurrence of the study sponsor, the study team reviewed and analyzed the Dugway data to determine its impact on this study and its possible impact on the recently completed Concept of Operations for NBC Defense in the Midrange[3] study. The initial

[3] Concept of Operations for NBC Defense in the Midrange, Marine Corps Development and Education Command, Quantico, Virginia, 15 June 1981.

Table 3. The MAGTF NBC Casualty Handling System Concept

FUNCTION OR CAPABILITY	SELF/BUDDY AID	LITTER BEARER	HOSPITAL CORPSMAN	BATTALION AID STATION/ EVACUATION STATION	MEDICAL COMPANY & HOSPITAL COMPANY
Triage	None	None	Minimal	Initial	Definitive
Casualty CW Treatment	Administer CW therapy from individual issue Apply contamination resistant wound dressing	Administer CW therapy from individual issue Apply contamination resistant wound dressing	Administer additional CW therapy from medical supplies Apply contamination resistant wound dressing	Administer additional CW therapy from medical stocks Provide assisted ventilation	Administer additional CW therapy Provide assisted ventilation
Casualty Decontamination	Emergency with individual M258A1 and M13 kits	Emergency with individual M258A1 and M13 kits	Emergency with casualties M258A1 and M13 kits	Emergency with casualties M258A1 and M13 kits	Complete at Decontamination Center
Casualty NBC Protection	Individual NBC protective ensemble	Individual NBC protective ensemble	Individual NBC protective ensemble	Individual NBC protective ensemble	Collective protection for: Patient holding and processing Patient treatment Patient nursing
Casualty Evacuation	Contaminated	Contaminated	Contaminated	Contaminated Assisted ventillation Vehicular collective protection	Contamination free in patient wrap or vehicular collective protection
Special Medical/ NBC Capabilities	None	None	None	Vital signs monitor for NBC protection ensembles Contamination free fluid/ drug administration Low level contamination monitor CW resistant surgical gloves Improved respiratory protection with minimal degradation	Decontamination of medical staff and equipment Collective protection for medical staff rest and relief and critical medical support functions Laboratory X-ray Pharmacy Contamination free storage for medical supplies Low level CW vapor detection Patient contamination detection CW dosimeter for medical staff CW resistent surgical gloves Improved respiratory protection with minimal degradation

assessment of the Dugway data is summarized as follows:

- The new persistence/evaporation model (Dugway) is more useful than the current models.
- Due to the limited amount of actual test data, both laboratory and field tests, data gaps still exist that limit absolute confidence in all chemical effects analyses.
- The tactical situations presented in the Dugway report are not adequate for USMC requirements.
- Environmental data (weather) used in the Dugway report tactical situations are too restrictive to meet USMC needs.

The Dugway data are more closely aligned with the available observed data than are the other predicted data, and there is a significant variation in the evaporation rates. It must be remembered that both sets of casualty prediction data are based on an extremely limited open air, live-agent test base that does not conclusively substantiate either set of data. However, the study team believes the Dugway data is as valid as any current data available, and as such, offers the Marine Corps commanders options which make mission accomplishment in a chemical environment more easily achievable.

The casualty estimates which have been developed with the Dugway data were, in most cases, as had been anticipated. The more rapid evaporation of the threat agent reduced the area of off-target hazard which, in turn, reduced the number of exposures to the agent, thus lowering the estimated casualties. Additionally, these Dugway evaporation figures significantly reduce the duration of the hazard, again reducing the number and length of exposures which, in turn, reduce the expected casualties.

This expected reduction in casualties, while being very significant to the military planner, is by no means the only meaningful use of the Dugway data. The results of the CAT analysis, and a review of the Dugway report, indicate several areas of NBCD where the Dugway data may have an impact. The study team evaluated the impact on each of the NBCD functional areas and for each of the elements of these NBCD areas as presented in the NBC readiness study. The results of this analysis are summarized in table 4.

Table 4. Impact of Dugway Data Assessments on NBCD Functional Areas

	Doctrine	Organization	Equipment	Training
Detection	●	●	●	●
Identification and Warning	●	●	●	●
Protection	+	●	+	++
Decontamination	++	+	++	++
Medical Aid	+	+	++	++

++ Major impact
\+ Minor impact
● Insignificant impact

2. SUMMARY

During previous studies it was determined that the FMF had a limited capability to survive a chemical or biological agent attack based primarily on the individual Marines NBC protective equipment. However, it was determined that the MAGTF could not conduct sustained operations in an NBC threat environment. This deficiency was due to a lack of effective decontamination and collective protection doctrine and resources which are critical to prolonged operations in a contaminated area. In addition, the capability of the Medical Service to cope with the number and type casualties which could result from the enemy use of NBC weapons during amphibious operations was judged to be severely limited.

This study has evaluated each of these critical areas of NBC defense (decontamination, collective protection, NBC casualty handling) as they interface with each other and the overall amphibious operation. In each of the areas, very specific recommendations have been provided in the respective chapters of this report. A summary of the studies, conclusions, and recommendations has been presented in Chapter 6 to provide the reader with an overview of what corrective actions have been identified. Timely action on these recommendations and effective follow through of the implementing actions should be a high-priority item at Headquarters, Marine Corps. The attainment of an improved NBC defense capability as detailed in this report will overcome a glaring deficiency and greatly enhance the FMF capability to conduct successful amphibious operations in an NBC threat environment.

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MARINE CORPS REQUIREMENTS AND PROCEDURES FOR

DECONTAMINATION AND COLLECTIVE PROTECTION

VOLUME I

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MARINE CORPS REQUIREMENTS AND PROCEDURES FOR
DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 1

INTRODUCTION

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR

DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

The NBC Defense Readiness Study[1] describes Soviet emphasis on first use of nuclear, biological, and chemical (NBC) weapons for maximum effectiveness. Both persistent and nonpersistent agents can play large roles in Soviet operations. This strong possibility establishes a requirement for the Marine Corps to be able to carry out combat operations in a contaminated environment. Such a capability calls for an efficient system of decontamination. Hand-in-hand with an effective decontamination policy is the need for individual and collective protection. Presently, individual protection is detailed by the Marine Corps, but collective-protection measures are still being refined.

The need for a comprehensive decontamination and collective-protection doctrine is identified in the NBC Defense Readiness Study. The study emphasizes that this doctrine is fundamental to the success of continued mission operations in an NBC environment. To be able to use its equipment without either taking casualties or accepting the degradation in performance of wearing protective clothing, a unit must be capable of decontaminating that equipment. An alternative to active decontamination is to allow the contaminated equipment or material to weather until it becomes clean enough to handle without protective equipment. Finally, in order to reduce the decontamination requirement, a unit can take certain actions prior to contamination; these

[1] Nuclear, Biological, and Chemical Defense (NBCD) Readiness in the Mid-Range Period (1978-1990), Marine Corps Development and Education Command, Quantico, Virginia, May 1980. SECRET

actions can be classed as contamination-avoidance measures. Any comprehensive decontamination doctrine will contain elements of all three of the above measures which, when taken in a timely fashion, will minimize the impact of a persistent chemical-agent attack on combat operations.

There will be times in a combat situation when individuals and units will be forced to remain in an NBC-contaminated environment for prolonged periods. In these cases when some means of decontamination is not possible or practicable, then some collective protection is required.

The purpose of collective protection is to provide a protective environment wherein; (1) individuals can carry out tactical functions efficiently without the encumbrance of individual chemical and biological protective equipment; (2) individuals can find relief from wearing individual protective equipment and can eat, sleep, and perform personal hygiene; and (3) that can be used as a clean area for key personnel in case of a chemical attack. Typical tactical situations requiring collective protection are found in command posts, communications centers, fire-control stations, missile-control complexes, first-aid stations, hospitals, and rest-and-relief stations.

It may also be necessary to provide protection for certain tactical equipment. The complexity and possible vulnerability of electronic equipment may make the equipment itself the prime target of an attack. The potential corrosive action of smoke and other common agents, or the employment of antimaterial agents could render the equipment inoperable or cause it to malfunction.

As a result of the use of chemical weapons on the battlefield, a significant number of casualties will require different handling than will a conventional casualty. Numbers of casualties resulting from initial use of

chemical weapons against unprepared Marines may overwhelm the current casualty-handling system. However, as soon as treatment units have recovered from the initial shock of increased casualties, they must be able to continue to provide the best available medical support. A system must be devised that will provide for the handling of chemical casualties as well as for conventional casualties who may be contaminated. Additionally, the problem of biological-agent casualties must be considered in the overall context of NBC casualty handling.

The Commandant of the Marine Corps tasked the Commanding General, Marine Corps Development and Education Command (CG, MCDEC) to conduct a study of decontamination and collective-protection procedures and requirements and NBC casualty handling that would provide a subjective analysis to evaluate and recommend requirements and procedures for decontamination, collective protection, and NBC casualty handling.

1.2. OBJECTIVES

The initial objectives for the Marine Corps Requirements and Procedures for Decontamination Collective Protection study, as approved by the sponsor, are listed below.

- Determine levels of chemical contamination within which Marine air-ground task force (MAGTF) units may be required to operate using the projected midrange inventory.
- Identify specific material requirements and procedures for vehicles, aircraft, and personnel decontamination.
- Identify collective-protection requirements, types of collective protection, and procedures for Marine Corps units in a combat environment. This will include air and ground combat-maneuver units, combat support, and combat service support in an amphibious operation.

- Describe a handling and movement system for NBC casualties.

The following additional objectives were added to the study plan in order to provide up-to-date analysis based on additional technical data obtained from a Dugway Proving Ground draft report.[2]

- Review and analyze the report titled Effects of Chemical Attacks on Tactical Staging Operations (SECRET).
- Identify the critical assumptions made in the Dugway report, and compare their implications with, and contrast to the currently accepted data being used in this study.
- Determine where the new data might have an impact on NBCD doctrine and make alternative recommendations to modify that doctrine.

1.3. MAJOR FACTORS

The following major factors are considered in this study at the direction of the study sponsor:

- The mission of the Marine Corps will be in accordance with the Marine Corps Mid-Range Objectives Plan (MMROP) and capability needs as defined in the NBC Defense Readiness Study (SCN: 30-78-03).
- The study analysis will include data from U.S. Army Dugway Proving Grounds, Effects of Chemical Attack on Tactical Staging Operations, Dugway, Utah, Dr. Chinn, Draft Report, November 1980, SECRET.

[2] Effects of Chemical Attack on Tactical Staging Operations, U.S. Army Dugway Proving Grounds, Utah, Draft Report, December 1980. SECRET.

1.4. SPONSOR GUIDANCE

This subparagraph contains guidance by the sponsor as stated in the study plan.

> A detailed review of all available literature on collective protection, decontamination, and mass casualty management systems will be conducted.
>
> The tables of equipment (T/Es) of Fleet Marine Force (FMF) units will be examined to identify those items available in the present system that may be applicable for collective protection with slight modification. In addition, the Marine Corps expeditionary shelter system will be examined to determine its applicability for use as a collective-protection system.
>
> - A data base of decontamination equipment, material, and procedures should be developed which will include US sources as well as North Atlantic Treaty Organization (NATO), allied, and Warsaw Pact (WP) sources which are available.
> - A data base for collective-protection systems should be developed.
> - Field visits should be conducted to evaluate the best decontamination and collective-protection systems.
>
> Perform a cost benefit analysis of alternative procedures specified in the preceding two paragraphs.
>
> All recommendations will be in concert with the "Concept of Operations for NBC Defense in the Mid-Range" study.[3]
>
> If a computer simulation model(s) is developed during the course of this study, documented software will be delivered to the Marine Corps for evaluation. Software must be compatible with current Marine Corps computers.
> Develop a study plan for review by MCDEC and Headquarters, U.S. Marine Corps.

1.5. ASSUMPTIONS AND SCOPE

The study is based on the following sponsor-approved assumptions.

- Missions of the Marine Corps will remain unchanged in the midrange period.

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[3] Concept of Operations for NBC Defense in the Mid-Range, Marine Corps Development and Education Command, Quantico, Virginia, June 1981. SECRET.

- The Soviet/WP NBC threat as refined in the "Concept of Operations for NBC Defense in the Midrange" study is the basic threat for this study.
- Decontamination of chemical agents presents the most severe impact and is considered the base case in this study.
- Biological attacks will be a strategic operation and, therefore, present limited threats during the assault phase of the amphibious operations.
- Funding and manpower considerations require that decontamination and collective-protection systems be maintained at a minimum level consistent with successful combat operations.

Defense against NBC warfare is considered as an entity in this study with primary emphasis on decontamination and collective protection from chemical agents. Protection against residual nuclear radiation and biological agents is considered in the overall decontamination and collective-protection requirements for the Marine Corps during amphibious operations. Reviewed data indicate that many protective measures (decontamination and collective protection) taken in response to a chemical attack will provide adequate measures for a biological-agent attack and residual nuclear radiation. Decontamination of biological agents and residual radiation is, however, given consideration throughout this study.

In the handling of NBC casualties, this study assesses the impact of basically two types of casualties on the current casualty-handling system. These casualties require special handling techniques with respect to the contamination level. The first type of casualty results from exposure to a chemical agent and, therefore, requires specialized treatment consistent with the type of agent involved. This special treatment requires additional

quantities and types of medical material some of which are not currently available in the USMC medical system. The second major category of NBC casualties are those which have been exposed to or contaminated by an NBC agent and who are also suffering from a conventional type of wound.

1.6 APPROACH TO THE STUDY

The initial step for this study was acquisition, classification, and tabulation of data. This data base which was presented in the first interim report of this study focuses on the most current available information on decontamination, collective protection, and NBC casualty-handling equipment; and on material and procedures. This data base was developed by pragmatic and experiential assessment of relevant literature and information obtained from fact-finding visits for this and the previously mentioned NBCD concept of operations study.

NBCD, and related information, is a dynamic subject within the military community; new and significant data are being developed by various sources continuously. Because of the rapidly changing nature of NBCD, the study team continued its data collection efforts throughout the period of the study until November of 1981. Data collection visits were conducted with elements of the FMF to obtain operational "hands on" type of information from the user's point of view, in addition to visits to other military service agencies.

The study team found it difficult to cut off its data collection efforts because of the dynamic nature of NBCD, and, because of the desire to ensure that the Marine Corps has the best and most recent information available. This desire, and the sometimes inordinate delay in obtaining data, caused some unavoidable delays in the completion of the study tasks, and, thus,

resulted in the necessity to extend deliverable dates. In excess of 300 documents were reviewed for the data base developed for this study.

The next step in the study was determination of levels of chemical contamination in which a MAGTF will be required to operate. A continuing tactical situation within which NBC weapons are employed was developed in order to generate a realistic representation of continuing and repetitive contamination, its spread, and decay.

The principal analytical tool used to assess the expected combat environment was a kinematic analysis using the combat assessment technique (CAT) developed for the "Concept of Operations for NBC Defense in the Midrange" study. The CAT involves systematic, computer-assisted manual wargaming based on situations postulated in the modified MARCORS-1A[4] scenario to develop realistic combat engagements and quantify the effects on battle results of changing selected independent variables. Such variables can include tactics, terrain, force structure, and various conditions associated with the use of chemical weapons.

The CAT data base used in the "NBCD Concepts of Operations" study was updated to reflect MARCORS-1A conditions and the chemical assessment routine was modified to provide sensitivity to different levels of contamination. A baseline application of the CAT was made in order to establish the general parameters of the tactical situation.

The description of the battlefield developed by the CAT was utilized in establishing a decontamination system that identifies the requirements

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[4] Marine Corps Midrange Threat Scenarios and Target Lists Study (Phase II), MARCORS-1A, Marine Corps Development and Education Command, Quantico, Virginia, June 1980. SECRET.

and procedures for a MAGTF in an NBC environment. Specifically, in order to assess the impact of NBC contamination on their mission, commanders will have to know which type of contaminant exists; what the extent of contamination is; how hazardous to personnel is the contaminant; and what level of decontamination is required in order to reduce the hazard to an acceptable level.

In order to continue sustained operations on the integrated battlefield, the NBC readiness study identified the requirement for some form of collective protection for the MAGTF. Marines cannot operate indefinitely in chemical-protective equipment. Their performance will be impaired in mission-oriented protective posture MOPP-4 (see paragraph 3.1.2.2). Often it will not be possible to locate, and operate in, clean areas. Units then must operate continually either at MOPP-3 or -4, or utilize collective protection.

The next step in the study was development of a collective-protection system based on the CAT description of the integrated battlefield and the ensuing recommended decontamination system. The collective-protection system considered the four types of collective protectors:

- Combat-vehicle systems
- Simplified collective-protection systems
- Modular collective protection
- Special collective protection

Using the output from the CAT described previously; the location, level, and frequency of contamination on the battlefield was used by the study team as a base for experiential assessment and deductive reasoning to estimate the number and distribution of resulting conventional, chemical, and conventional-plus-chemical casualties.

The study team examined the impact of these types of casualties on the current casualty-handling system. These casualties will require, at the minimum, special handling techniques with respect to the contamination level. Included in this analysis was an experiential and intuitive estimate of handling/treatment times by casualty and treatment centers, the identification of special skills/occupations required to handle NBC casualties, the identification of additional equipments, facilities, and so forth, necessary to handle these casualties at each treatment center. The results of this analysis provided the basis for deductions of additional resources required to effectively handle NBC casualties during amphibious operations.

An additional requirement was defined by the study sponsor that resulted from data obtained during the data base development. This information obtained from the U.S. Army, Dugway Proving Grounds, Utah, appeared to present a significant impact on data being utilized in the CAT wargame simulations. Specifically, the "accepted standards" for chemical agent contamination decay based meteorological conditions are significantly different from the standards postulated in the Dugway information. The study sponsor directed that a review of the Dugway information be conducted to determine how significantly it impacted on the original study objectives. A diagram of the study task sequence, as revised to include this final additional requirement, is presented in figure 1-1.

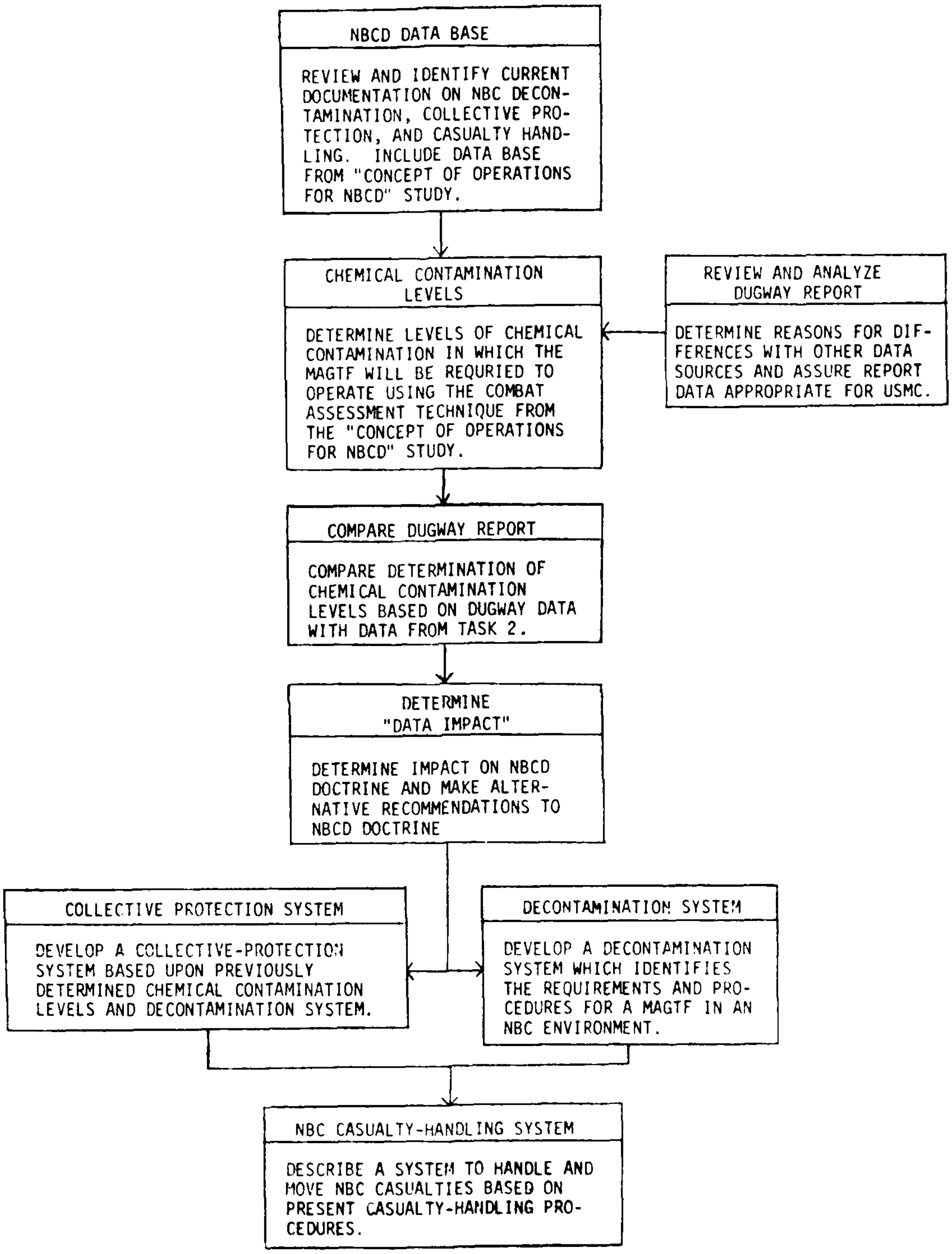

Figure 1-1. Revised Study Task Sequence

1.7 THREAT OVERVIEW

The NBC warfare capabilities of the Soviet Union and the WP nations have been recognized in recent years as an area of concern to the U.S. and NATO military planners. Although this threat itself (on a classified level) is not new, a new, broader sense of awareness (on an unclassified level) of the seriousness of the USSR chemical warfare (CW) and biological warfare (BW) capability has developed. An indication of this general awareness is the reporting of events in Afghanistan (reported use of chemical agents) during 1980 by such media as Time Magazine, New York Times, U.S. News and World Report, Washington Post, and numerous television networks.

The most recent (and more disturbing) information on the use of mycotoxins in Southeast Asia further points to the awesome NBC capability of the Soviet Union. While mycotoxins are not considered a traditional chemical warfare agent, they have many similar tactical applications and provide another indication of the acceptance of this type of combat use of NBC agents by the Soviet planners. A recent editorial in the Wall Street Journal sums it up as follows:

> Except to the willingly obtuse, the evidence is conclusive. The Soviets have long been engaged in the development and production of chemical and biological weapons. They have used these warfare agents in Yemen in the 1960s and now in Cambodia, Laos, and Afghanistan. In addition to its intrinsic brutality, this kind of warfare amounts to a calculated and massive violation of international arms control agreements.

The Soviet chemical arsenal is oriented toward offensive action. Their weapons and delivery systems are sophisticated and effective; the lethal chemical agents are highly toxic. The Soviets are generally credited with having the full range of lethal chemical agents which include some World

War I-type agents as well as more modern nerve agents. A list of possible Soviet chemical agents includes:

- Blister agents - mustard
- Blood agents - hydrogen cyanide
- Nerve agents - Sarin, Tabun, Soman, VR-55

The Soviets have the capability of delivering their chemical agents on-target by a wide range of weapon systems. During World War II the Soviets had chemical artillery, mortars, mines, bombs, and spray tanks. Since there is no evidence that these weapons have been destroyed, it is reasonable to assume that they are still available and probably have been upgraded with newer nerve agents. Additionally, the Soviets have been credited with having chemical warheads for the FROG and surface-to-surface missiles as well as for the BM-21 multiple rocket launcher (MRL).

MRLs, and in some cases mortars and artillery, will probably be the primary means of delivery to achieve high concentrations of nonpersistent chemical agents with maximum surprise. Tactical rockets, missiles, and aerial munitions will be used to deliver persistent chemical agents on deep targets. Through the use of these multiple-delivery systems, Soviet or Soviet-equipped and -trained forces could initiate large-scale CW operations. Although available data on the Soviet CW stockpile are limited (it has been estimated that one-third of Soviet munitions have a chemical-agent fill), it is assumed that the stockpile is adequate to meet the combat tasks foreseen by Soviet planners; that production and storage capabilities would not limit the Soviet CW posture; that chemical munitions are sufficient to support sustained, high-threat chemical conflict; and that Soviet units are prepared for immediate resort to CW on the offensive.

Chemical agents will probably be used in "bands" within the force beachhead (FBH) where the degree of persistence would increase as one progresses from the FBH line (FBHL). Within a few kilometers (km) of the contact, the primary agents will most likely be nonpersistent agents with various vesicants used to protect the flanks of the axis of a counterattack. Farther into the FBH the primary agents would be nonpersistent nerve agents with some usage of thickened nerve agents and vesicants on high-priority targets. Toward the beach support areas persistent nerve agent would likely be used with some employment of nonpersistent nerve agents or vesicants. The result of employment of a persistent chemical agent within an appropriate band will be the production of discrete contaminated areas of various sizes rather than complete saturation of the area within the band. It is these kinds of contamination with which the MAGTF will have to cope.

The opportunity for significant tactical success presented by the initial CW surprise attack provides the Soviet command with a tempting "trump card" to be played at its discretion. The CW attack could be used to achieve a tactical advantage over Marine forces. There is little reason to assume that the Soviet introduction of chemical weapons into conventional conflict would result in the escalation of that conflict to a nuclear level. The possibility of a Soviet crossing of the tactical nuclear threshold would be further diminished if a significant portion of the Marine force were put out of action for extended periods by the initial CW attack.

Although the Soviet Union has signed and ratified the Biological Weapons Convention, the reporting of biological agent-related deaths in Sverdlovsk, and the reported use of toxins in South East Asia, has raised the issue of

BW again. This is one area where little hard intelligence is available; however, some data can be evaluated.

Although Soviet munitions designed specifically for disseminating BW agents have not been identified, some delivery systems with modifications for CW agents could be utilized for BW agents. Past Soviet research efforts have provided the Soviets with a significant number of possible BW agents and the techniques for producing and weaponizing those agents. Possible systems include aerial spray tanks, artillery, surface-to-surface missiles (SSMs), multiple rocket launchers, FROG, and bombs. To ensure the safety of their own forces, Soviet employment of BW agents would probably be limited to deep targets several hundred kilometers from the forward edge of the battle area (FEBA).

The Soviet/WP nuclear capability has long been recognized and documented. The Soviet and WP forces have the weapons and delivery systems to engage in effective nuclear operations on the level of their choosing; military forces which must face them must be prepared to face a nuclear exchange.

The probability of the Soviet use of nuclear weapons is a matter of much discussion within the U.S. and NATO arena. However, it is interesting to note that although the Soviets engage in arms control and limitations talk with much maneuvering in the news media, their general staff presents a different view as the following quote indicates:

> The decisive means of achieving the goals of modern war are rocket and nuclear weapons, with their unlimited effective range and tremendous destructive capabilities.... The most important tasks of the General Staff in preparing for a modern war is the detailed planning of the employment of nuclear weapons by all services of the armed forces.[5]

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[5] Quoted in Joseph D. Douglass, Jr., A Soviet Selected Targeting Strategy Toward Europe. (Arlington: Systems Planning Corporation, 1977), p. 16.

Another journal item declared:

> For the achievement of victory in a present day nuclear war, if it is unleashed by the imperialists, not only the enemy's armed forces, but also the sources of his military power, the important economic centers, and also points of military and state control as well as the areas where different branches of armed forces are based will be subject to simultaneous destruction.[6]

In summary, there is a real distinction between what the Soviet officials are saying for public consumption--that is, accommodation and some sort of arms parity with the U.S.; and what they are doing--that is, building tactical and strategic forces that will be far superior to those of the U.S. An awareness of this military philosophy by Marine Corps commanders and staff is essential in planning future Marine Corps operations.

The preceding has been a brief overview of the NBC threat to the Fleet Marine Force. A much more complete and detailed description is contained in annex C, volume II of the Nuclear Biological and Chemical Defense (NBCD) Readiness in the Mid-Range Period (1978-1990) and annex C, volume II of the Concept of Operations for NBC Defense in the Midrange. These reports present the specific agent weapon threat data used in the CAT and presented in annex A, volume II of this report.

1.8 STUDY REPORT FORMAT

This final report is structured for ease of handling, reading, and implementation. To the maximum extent possible, the recommended systems of decontamination, collective protection, and NBC casualty handling have been discussed and described at the unclassified level in volume I. The classified weapons effects data and the wargaming data developed by the CAT are provided

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[6]Ibid., p. 26.

in volume II which is classified SECRET. Our intentions are to put the "what," "how," "when," and "where" of the recommended systems into volume I, and explain the "why" in the classified volume II. In some case this may require the reader to refer to volume II for specific data of a classified nature in order to fully understand the reasoning behind the recommendations in volume I. However, all the information on the systems, and detailed requirements to implement these systems, are contained in volume I.

Chapter 2, this volume, presents a comprehensive review of the decontamination problem faced by the MAGTF and details the requirements for a decontamination system recommended for implementation by the FMF. Chapter 3 provides an evaluation of the collective protection needs against the current assets in the MAGTF, and then describes the collective protection system and requirements necessary for the FMF. In chapter 4, the impact of NBC casualties, and the hostile NBC environment on the MAGTF medical system, are assessed and a system is proposed for the handling of NBC casualties. Chapter 5 contains an evaluation (based on the classified data in annex B) of the impact of the Dugway data on the NBC Defense Concepts and Doctrine recommended in the Concept of Operations for NBC Defense in the Midrange report. Recommendations for changes to this report as a result of this evaluation are provided in chapter 5. Finally, chapter 6, provides a summary of this study effort and the study team's conclusions arrived at by the study team on the overall subject of NBCD and chemical operations in the FMF.

Volume II of this report contains the detailed, classified description of the chemical threat, projected contamination and its effects on the MAGTF as developed in the CAT of the MARCORS-1A scenario in annex A. Annex B of the volume contains data on threat contamination comparisons obtained from the FMFM[7] and Dugway report data exercised in the CAT. Annex C contains a bibliography of the most significant sources used in this study.

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[7] FMFM11-3, Employment of Chemical Agents, Departments of the Army, the Navy, and the Air Force, 26 February 1971. UNCLASSIFIED.

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR
DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 2

DECONTAMINATION SYSTEM REQUIREMENTS

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR

DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 2. DECONTAMINATION SYSTEM REQUIREMENTS

2.1 INTRODUCTION

2.1.1 Background.

Sophisticated weapons systems, both conventional and NBC, are widely available among the U.S., its allies, and the threat nations. The threat nations are capable of employing nuclear, biological, and chemical (NBC) weapons in large numbers, and their delivery systems have great mobility and range. NBC weapons are viewed by the threat nations as "weapons of mass destruction." Heavy emphasis is placed on nuclear and chemical warfare as alternate means in conventional warfare, this is to achieve surprise, decisive force, and deep penetration and maneuver. A more detailed discussion of the threat was presented in chapter 1, and in the Concept of Operations study[1] and will not be readdressed.

All NBC weapons have an inherent residual effect that presents a hazard to both forces engaged. Nuclear bursts create local contamination of an area around ground zero and may produce radioactive fallout that can contaminate thousands of square kilometers (km). Some chemical and biological agents create airborne hazards that can be carried downwind for long distances; others can contaminate terrain with long term effectiveness. The areas affected by airborne residue are determined primarily by the speed and

[1] Concept of Operations for NBC Defense in the Mid-Range, Marine Corps Development and Education Command, Quantico, Virginia, June 1981. SECRET.

direction of the wind in the target area, and the persistency of the agent used. The contamination of NBC weapons is a necessary consideration in pre-planning future operations in which friendly forces may be required to occupy previously contaminated terrain. The NBC contaminants can inflict significant casualties, and restrict effective use of terrain, buildings and material. Each of the three types of contaminants poses its own particular hazard and requires different methods of decontamination. Combat operations can be severely hampered by the effects of NBC contamination and the commander must be able to assess their impact on mission accomplishment. To do this the commander must be able to answer the following questions:

- Which type of contamination exists?
- How hazardous is the contamination to personnel?
- What level of decontamination is required to reduce the hazard to an acceptable level?

2.1.2 Decontamination concepts.

This chapter describes and recommends a decontamination system for a Marine air ground task force (MAGTF), which will counter the threat and allow sustained combat operations in an NBC environment.

This proposed decontamination system is based on the following decontamination principles:

- Decontaminate only if it enhances combat effectiveness. The objective of decontamination is to reduce or eliminate NBC hazards so that it is easier to accomplish the mission. If available resources cannot accomplish the decontamination objective, then decontamination should be delayed until necessary resources are available.

- Decontaminate as far forward as possible. This principle is based on the premise that every available Marine and piece of equipment will be needed to service enemy targets, and to support and sustain the battle.
- Decontaminate as soon as possible. Certain types of decontamination must be done if Marines are to survive, and if units are to accomplish their mission.

The decontamination system is also based on an NBCD concept that incorporates, among other things, the following types of decontamination:

- Emergency decontamination--removal of contaminants from exposed parts of the body. This must be done to enable the individual Marine to survive. It can be done without adversely affecting the mission, and must be done to reduce the risk of excessive casualties.
- Partial decontamination--partial removal of NBC contaminants from individual clothing and equipment. This must be done to enable Marines and their units to continue operations (mission accomplishment with dynamic survivability--MADS concept) in an NBC environment. Partial decontamination minimizes or reduces the hazard, limits the spread of contaminants, and makes complete decontamination easier at a later time.

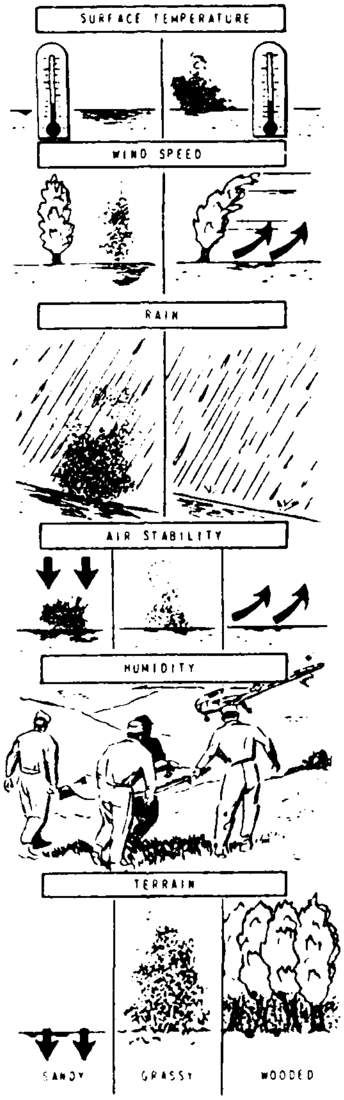
- Limited decontamination--partial removal of NBC contaminants from unit equipment. This must be done to reduce contamination on critical areas of equipment that must be handled or used by Marines in the accomplishment of their mission.
- Complete decontamination--removal of most or all NBC contaminants from personnel, equipment, terrain, and facilities. This is done by specialized decontamination units and requires help from other units. Complete decontamination; a difficult and resource-intensive method of decontamination, has a severe impact on the mission, and requires many hours of effort.

Of further consideration in developing decontamination concepts is the effects of weather on the contamination concentrations. Generally, the weather elements reduce or inhibit the effects of contamination to varying degrees.

Rainfall will wash radiological contamination off of objects and thus concentrate radiation in pools of water. Weathering has no other effect on radiological contamination except to displace it physically from one location to another.

Weather affects most biological agents through dehydration and exposure to sunlight. Elements of weather that affect the persistency of chemical agents are illustrated in figure 2-1, and listed as follows:

- Temperature. High temperature speeds evaporation and hastens the dispersion of chemical agents in the air, increasing the vapor hazard.



EFFECT ON VAPOR CONCENTRATION	WEATHER AND TERRAIN CONDITION	EFFECT ON LIQUID CONCENTRATION
The higher the ground temperature the greater the rate of evaporation and the shorter the time to obtain effective vapor concentrations.	SURFACE TEMPERATURE	Persistency of liquid blister agent on the ground decreases as ground surface temperature increases.
Wind carries vapor away faster than the increase in rate of evaporation can replace it. Vapor concentrations decrease as wind speeds increase.	WIND SPEED	Wind shortens persistency. The persistency of liquid H is approximately in inverse proportion to the wind speed; for example, if wind speed doubles, time of persistency is approximately halved.
Heavy or lasting rains prevent formation of effective vapor concentrations. If persistent effect agent is laid down immediately after a heavy rain, high vapor concentrations are usually attained. Light showers falling on an area shortly after contamination with mustard agent cause a temporary increase in the rate of evaporation of the mustard agent.	RAIN	Heavy or lasting rains wash away liquid blister agent. Light rains increase contact hazard but slightly decrease persistency.
Neutral or inversion conditions favor attainment of higher vapor concentrations than lapse conditions.	AIR STABILITY	Under lapse conditions, all other conditions being equal, evaporation is more rapid and persistency shorter. Persistency is greater under neutral conditions and still greater under inversion.
High humidity coupled with high air temperature increases susceptibility of personnel to the blistering action of blister agent vapor.	HUMIDITY	High humidity coupled with high air temperature increases susceptibility of personnel to the blistering action of liquid blister agent.
In the open, concentrations are higher over grass or brush than over sand. In heavy woods or jungle, degree and persistency of concentrations are greater than in the open. On hilly terrain, only uniform coverage insures concentrations on hill crests.	TERRAIN (SANDY, GRASSY, WOODED)	On sandy or permeable soil, liquid blister agent seeps beneath the surface and persists, but contact danger is reduced. On grassy or brushy terrain, persistency is short, contact danger is great.

The information above is pertinent for all the persistent effect agents (mustard series, lewisite, GA, VX) and for the nonpersistent effect GB. In addition to the effect of rain, considerable and rapid hydrolysis of lewisite will occur removing the vapor hazard from this agent but leaving a solid residue which is highly toxic. Some hydrolysis (neutralization) of the G-agents will also occur, but it is very slow.

NOTE: From TM3-220, Chemical, Biological, and Radiological (CBR) Decontamination, Department of the Army, November 1967. UNCLASSIFIED.

Figure 2-1. Weather Factors That Affect Persistency of Chemical Agents

Persistency of liquid agents on the ground decreases as temperature increases.

- Wind. Winds disperse vapors of chemical agents.
- Humidity and rain. Moisture tends to break down chemical agents and rain reduces contamination by washing agents off of objects.
- Sunlight. The thermal effects of sunlight hasten evaporation of chemical agents.

2.1.3 <u>NBC effects on amphibious operations</u>.

The impact of NBC contamination on an amphibious operation could be catastrophic to an unprepared and untrained landing force. The uniqueness of the amphibious assault, especially the initial projection of forces ashore, creates vulnerabilities which invite exploitation by NBC weapons and in particular chemical weapons (CW) systems.

The effects of a nuclear attack on an amphibious force in the amphibious objective area (AOA) would severely limit the capability of that force to successfully project power ashore. A nuclear attack on the amphibious force during the critical ship-to-shore phase would completely disrupt the landing schedule and stop the assault.

Once in the AOA the ships of the task force become easy targets for CW munitions. Besides the vulnerability of the task force shipping, the ship-to-shore movement phase could easily be disrupted and the buildup of forces ashore would be slowed down, if not completely stopped.

A CW attack on the beach area would require assault personnel to operate in a contaminated area for extended periods of time if alternate beaches and helicopter landing zones were not available. Such operations could

slow the momentum of the assault. Helicopter support and beach group personnel would be subject to heat stress and communications degradation which would further slow down the buildup of personnel, supplies, and equipment ashore.

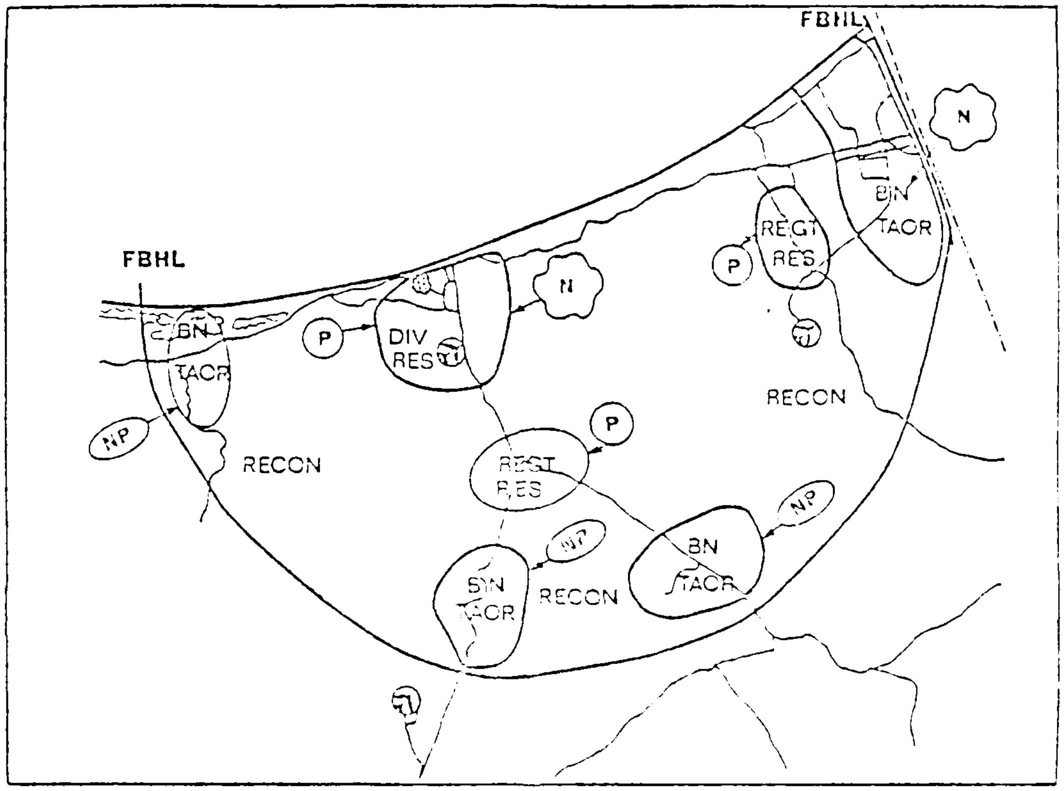
CW agents sprayed on salt water could present additional hazards to personnel since, not only would the water be contaminated, but, the wave action would generate a contaminated spray.

The problem of contamination to helicopters, landing craft, and boats scheduled for turn-around loading at the various ships present another critical point in amphibious operations. Mother ships must be equipped and trained to deal with this contamination and the resulting contamination tranfer.

Finally, heavy NBC casualties during the initial build-up could cause congestion and impede the timely seizure of landing force objectives. Casualty handling must consider the requirement for evacuation from contaminated beaches to clean ships.

The force beachhead (FBH) would become an integrated battlefield if nuclear and/or chemical weapons are employed to drive the landing force back into the sea. A schematic of an FBH when nuclear and chemical (NC) weapons are employed against the landing force is shown in figure 2-2.

The requirements for contamination avoidance and decontamination procedures for survival and mission accomplishment are critical planning factors in an amphibious operation. The landing force commander (CLF) must be prepared to operate in a contaminated environment. NBC defense equipment must be selectively positioned to permit for timely movement ashore for decontamination where and when required. Amphibious ships must have the capability



LEGEND

BN TAOR--Battalion tact'cal area of responsibility
REGT RES--Regimental reserve area
RECON--Reconnaissance areas
DIV RES--Division reserve
FBHL--Force beachhead line
N--Nuclear contamination
P--Persistent chemical contamination
NP--Nonpersistent chemical contamination

Figure 2-2. Schematic of an Integrated Battlefield

to accept contaminated helicopters, boats, and landing craft for reloading of personnel and equipment. Planning must include the evacuation of nuclear and chemical contaminated casualties.

2.1.4 Decontamination requirements.

The nature of an amphibious operation conducted in toxic environments requires that various types and levels of decontamination be available if operations are to continue uninterrupted. Decontamination is based upon the following considerations:

- The risk of taking casualties if decontamination is not done
- Time and resources required in the decontamination effort
- Capability of unit or individual soldier to perform decontamination
- Impact of decontamination on the mission

These considerations must be examined with the factors of types and principles of decontamination to determine the most efficient system; that is, one which allows survival and mission accomplishment.

This decontamination system should include the types of decontamination which were discussed in paragraph 2.1.2 and as shown in table 2-1.

There are three levels of responsibility for decontamination within Fleet Marine Force (FMF) operations:

- Individual. Individual decontamination are those measures performed by individual Marines on themselves, their personal equipment, and weapons in order to reduce contamination hazards so that they can survive to operate (STO).

Table 2-1. Types of Decontamination

TYPE	SURFACE AREA	ACCOMPLISHED BY	EQUIPMENT
Emergency	Exposed Skin	Individual	Individual decontamination kit (e.g., towelettes).
	Open wounds.	Individual/company corpsmen.	Special equipment and decontaminants.
Partial	Mask, gloves individual helmet, and load-bearing equipment (LBE).	Individual	Individual decontamination kit (e.g., 4-6 oz. aerosol can).
Limited	Only mission essential surfaces of items of equipment.	Operator/crew of a vehicle or weapon.	Special on-board decontamination apparatus.
Complete	Total or remaining surface area of equipment.	Battalion decontamination* team.	Battalion special* decontamination equipment.
	Total or remaining surface area of equipment.	NBC units (assistance to sptd units).	Special decontamination equipment.
	Combat uniform.	Laundry.	Regular laundry equipment with special decontaminants.

*When situation allows and only when the unit/equipment cannot be rotated out of battle area.

This level includes both emergency and partial decontamination procedures.

- Unit. Unit decontamination is performed by unit personnel on unit equipment as well as that decontamination performed by specially trained teams under supervision of the unit NBCD specialists using unit decontaminating equipment. Unit decontamination includes both limited and complete decontamination. Complete decontamination by units will be difficult because of personnel, equipment, time, and facility limitations that may conflict with mission accomplishment.
- Support. Support decontamination is that decontamination beyond the capabilities of the using unit. This level of decontamination is intended to reduce the contamination to the lowest level possible and is considered complete decontamination.

The methods of decontamination for the reduction of NBC hazards include:

- Covering - reduces effects of the hazard.
- Removing - transfer of hazard from one place to another.
- Confining - restricting, limiting the hazard to a specific area.
- Sealing - reduction of hazard effects by painting, plastering, resurfacing, etc.
- Chemicals - neutralization of hazard.

- Field Expedient
  - Burning - destroys both chemical and biological agents.
  - Explosives - blast paths through hazards.
  - Heat - speeds up hazard evaporation rate.
  - Cover - suitable local materials placed over hazard.

Table 2-2 lists the current decontamination methods in order of preference by agent. These levels and methods span the types of decontamination and place the responsibility for decontamination on the individual, the organization commander (platoon through regiment/air group and Marine amphibious brigade (MAB) for units), and the division, wing, force service support group (FSSG) and Marine amphibious force (MAF) commander (for support decontamination). These decontamination requirements are shown in table 2-3.

Specific organizations within the division, wing and FSSG have a resident decontamination capability which exceeds the standard unit capability. An example of this capability is the engineer organizations which can decontaminate by covering and removing contaminated terrain, and can also test and purify water sources.

The current Marine Corps tables of Organization (T/Os) for headquarters battalion, Marine division (No. 1988); headquarters and service battalion, FSSG (No. 3449); and wing headquarters squadron, Marine aircraft wing (No. 8611) provide for key staff billets, limited capability decontamination and detection teams, and NBC watch team cadres. The decontamination and detection teams, the NBC watch team cadre, and a warrant officer are newly created

Table 2-2. Preferred Decontamination Methods Listed in Order of Preference

AGENT	CHEMICAL	THERMAL	MECHANICAL	RADIATION	OTHER
NERVE VR55 GB GD	1. CAUSTIC SODA SOLUTION (SODIUM HYDROXIDE) 2. DS-2 (DECONTAMINATION SOLUTION NO. 2) 3. WASHING SOLUTION (SODIUM CARBONATE) 4. STB (SUPERTROPICAL BLEACH) SLURRY 5. HOT SOAPY WATER	HEAT IS THE ONLY METHOD OF DECON-TAMINATION FOR SENSITIVE ELECTRONIC AND AVIATION EQUIPMENT	REMOVAL OF GROSS LIQUID FROM SKIN PROTECTIVE ENSEMBLE AND EQUIPMENT		PERSONNEL USE SOLUTION NO.1 FROM M258 KIT ON SKIN EXCEPT FACE. USE M13 KIT FOR FACE AND PERSONAL EQUIPMENT.
VX	1. HTH IS SOLUTION (CALCIUM HYPOCHLORITE) 2. DS-2 3. STB 4. COMMERCIAL OR HOUSEHOLD BLEACH SOLUTION (SODIUM HYPOCHLORITE)				
BLISTER CX	1. DS-2				
L	1. HTH-STB SOLUTION 2. DS-2 3. STB 4. COMMERCIAL OR HOUSEHOLD BLEACH SOLUTION		PERSONNEL FLUSH EYES WITH WATER		PERSONNEL USE SOLUTION NO.2 ON SKIN EXCEPT FACE. USE M13 FOR FACE AND PERSONAL EQUIPMENT
BLOOD [illegible] [illegible]	1. DS-2 2. CAUSTIC SODA SOLUTION				
CHOKING CG	1. DS-2 2. CAUSTIC SODA SOLUTION				
RIOT CN CS	1. CAUSTIC SODA SOLUTION 2. WASHING SODA SOLUTION 3. HOT SOAPY WATER				
BIOLOGICAL	5. FORMALDEHYDE BPL (BETA-PROPIOLACTONE) ETHYLENE OXIDE MOST CHEMICAL AGENT DECONTAMINATION SOLUTIONS DETROCHLORITE IODINE TABLETS (WATER PURIFICATION) DISINFECTANT, CHLORIDE FOR FOOD SERVICE PERACETIC ACID	4. FIRE	2. WATER (BOILING) 3. COVERING	1. SUNLIGHT	CHEMICAL DECONTAMINATION WILL BE USED WHEN THE SITUATION DOES NOT PERMIT OTHER METHODS
RADIOLOGICAL	4. ORGANIC SOLVENTS/PAINT REMOVERS CAUSTIC SODA SOLUTION ACID (SULFURIC & HYDROCHLORIC) OXIDIZING AGENTS 7. ION EXCHANGE		2. COVERING 3. WATER 6. FLOCCULATION 8. VACUUM BLASTING PREFERRED FOR EQUIPMENT WHEN SITUATION WILL NOT ALLOW WEATHERING	1. WEATHERING 5. ULTRASONIC WAVES	PERSONNEL BRUSH/ VACUUM CONTAMINATION OFF SELVES/EQUIPMENT

Table 2-3. Decontamination Requirements

Decontamination	Individual	Company/ Battery	Battalion/ Squadron	MAU	Regiment/ Group	MAB	Division	Wing	FSSG	MAF
Level of Responsibility		Unit					Support			
Emergency	Removal/neutralization of contamination on skin. Requires immediate action.									
Partial	Removal/Neutralization of NBC contaminates from individual clothing, equipment and weapons. As soon as tactical situation permits.									
Limited		Removal of NBC contaminants from critical operational areas of unit equipment. Must be accomplished as soon as the tactical situation permits.								
Complete							Removal of most NBC contaminants from personnel equipment, terrain and facilities. It is a difficult task and is resource intensive.			
Specialized Units							NBCD/ Engineer	NBCD/ Engineer	NBCD/ Engineer	
NBCD Command and Control			NBCD control center teams for decontamination coordination.							

billets which represent an austere NBCD improvement beginning that corrects many personnel deficiencies noted in the NBCD readiness study.[2]

2.2 REVIEW OF METHODOLOGY

2.2.1 Identification of decontamination requirements.

The identification of MAGTF decontamination requirements evolved from the pragmatic assessment of the NBC defense doctrine and concept of operations proposed in the Concept of Operations study[3] and on applicable, current and proposed U.S. Army NBCD doctrine. An analysis of the basis for these requirements was presented in paragraph 2.1.4.

The requirement for decontamination is also based on the threat doctrine for NBC weapon employment and contamination which classifies nuclear and chemical munitions as weapons of mass destruction. The threat doctrine for employing chemical contamination is that persistent (P) agents will be employed on units located toward the rear of the FBH and nonpersistant (NP) agents will be used on combat elements located near the forward edge of the battle area (FEBA). The possible contamination based on battlefield location is shown in figure 2-3.

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[2] Nuclear, Biological, and Chemical Defense (NBCD) Readiness in the Mid-Range Period (1978-1990), Marine Corps Development and Education Command, Quantico, Virginia, May 1980. SECRET.

[3] See footnote 1, page 2-1.

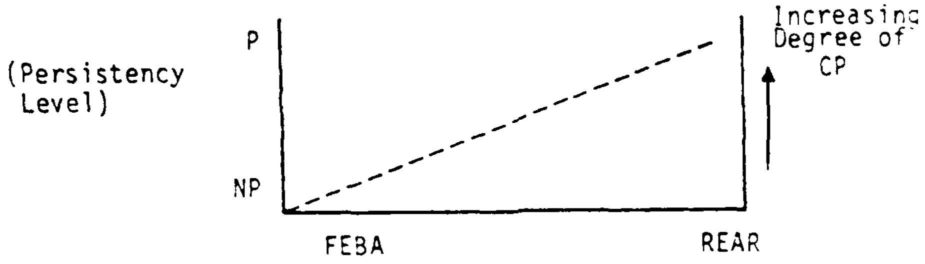

Figure 2-3. Possible Contamination Based on Battlefield Location

The problem of decontamination was considered in view of generalized mission requirements in this study; however, the degree of decontamination must rest on the commanders of the contaminated units in accordance with their specific situation and mission. The essential elements for decontamination which guide the decision are the three corners of the triangle in figure 2-4.

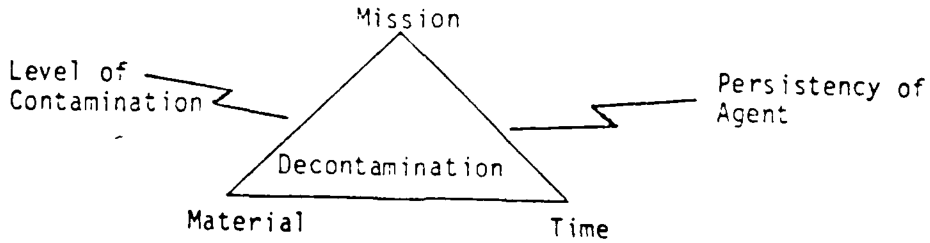

Figure 2-4. Essential Elements for Decontamination

A study team member visited NATO allies and the Israeli forces and received data on their decontamination operations and equipment which were evaluated for applicability to MAGTF operational concepts.

The analysis of the Dugway Proving Ground Draft Final Report, Effects of Chemical Attacks on Tactical Staging Operations (SECRET)[4], as presented in Volume 2 presents decreased durations of chemical agent hazards which further impact upon decontamination requirements. The NBC functional areas that deal with sustained operations in an NBC environment are the most sensitive to the Dugway calculations. Decontamination requirements, as one of these areas, are included as a sensitive area.

The Dugway predictions for contamination persistency were wargamed using MARCORS 1A scenario[5] input into the CAT to determine levels of contamination and their affect on MAGTF operations. These results were compared with an identical scenario which used the contamination prediction methods currently stated in Fleet Marine Force Manual (FMFM) 11-3 and North Atlantic Treaty Organization (NATO) standardized agreement (STANAG) 2103.

The results of this comparison provided a representative contamination pattern which affects MAGTF operations. This level of contamination dictates certain generalized decontamination requirements which were evaluated with the threat, mission requirements, and Marine Corps doctrine and concept of operations for NBCD results in the specific decontamination requirements proposed.

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[4] Effects of Chemical Attack on Tactical Staging Operations, USA Dugway Proving Grounds, Utah, Draft Report, December 1980. SECRET.

[5] Marine Corps Midrange Threat Scenarios and Target Lists Study (Phase II), Marine Corps Development and Education Command, Quantico, Virginia, June 1980. SECRET.

2.2.2 Selection of decontamination equipment and agents.

The review of current assets, developmental items, reports, and test results on decontamination equipment has been conducted by the study team and analyzed to determine the Marine Corps decontamination equipment and agent requirements which will be proposed in paragraph 2.7.

The selection of decontamination equipment by the study team is a result of a combination of factors. First, current decontamination equipment was investigated. This investigation included threat and allied equipment as shown in table 2-4 (pages 2-19 through 2-24), and U.S. equipment, shown in table 2-5 (pages 2-25 through 2-29).

Visits to NATO allies, Israel, the U.S. Army Chemical Systems Laboratory (CSL), Aberdeen Proving Ground, Maryland, Naval Surface Weapons Center (NSWC), Dahlgren, Virginia, and the U.S. Marine Corps NBC Development Project Officer at MCDEC provided the study team with developmental decontamination equipment data.

Reports and test results on decontamination equipment and agents were reviewed for applicability to Marine Corps needs.

The decontamination equipment and agents currently available, and those under development, were analyzed to determine if they met the unique Marine Corps amphibious operations requirements. Those items which had excessive cube and weight, as well as those that did not contribute to Marine Corps operational capabilities, were discarded.

2.2.3 Identification of costs. The costs profiles discussed in this study have been established through a review of documentation, visits, to CSL, NSWC, material developers, and discussion with the various Services. It is noted that the costs for developmental items (when available) are tentative figures provided as guidance for planning purposes. These figures,

Table 2-4. Foreign Decontamination Equipment and Agents

Country	Item	Unit of Issue	Remarks
United Kingdom	Decontamination Kit No. 1 MKI	Ea	Issued 1 per individual, and contains powder pads (fullers earth) for skin, equipment, and clothing decontamination.
	Decontamination Kit No. 2 MKI	Ea	Used for equipment decontamination. The kit contains one powder dispenser.
	Decontamination apparatus, portable (DAP)	Ea	Contains two gallons of solution and 3 refill kits.
France	M66 decontamination Kit	Ea	Contains decontamination powder and bentonite.
	Powder mitts	Ea	Contains fullers earth.
	M11 with DS2	Ea	2.5 liter apparatus. Allocation is 1 per small vehicle, 2 per large vehicle.
	12-liter decontamination pump.	Ea	Contains calcium hypochlorite solution. Allocated to company-battery-sized units.
	Trailer-mounted 600 liter decontamination unit, MKF4	Ea	Used at regimental level.
	F1 shower unit	Ea	Can process 120 to 150 personnel per hour.
West Germany	5-liter decontamination apparatus	Ea	Contains calcium hypochlorite.
	12-liter decontamination apparatus	Ea	Contains calcium hypochlorite.
	Individual decontamination kit	Ea	Contains decontamination powder, decontamination solution for equipment, blotting cloths, dressings, soap, and atropine injectors.
	5-ton truck with personnel decontamination.	Ea	1500 liter tank.
	7-ton truck decontamination apparatus	Ea	3000 liter tank, personnel and equipment decontamination.

Table 2-4. Foreign Decontamination Equipment and Agents (Cont'd)

Country	Item	Unit of Issue	Remarks
West Germany (Cont'd)	TS 2/5 decontamination unit	Ea	Power spray gun, transportable, weight--218 kilogram (kg).
	TS 8/8 trailer, fire fighting	Ea	Power spray gun, weight--1,750 kg.
	Water flow heater, transportable	Ea	With gasoline engine, weight--140 kg.
	Decontaminant set	Ea	Contains alkylarylsulphonate, insecticide DDT (powder and emulsion), bacteriological and fungicidal disenfectent, formalin solution, calcium hypochlorite, sodium hydrogen sulphate, sodium carbonate, various soaps, and cleaning material.
	Decontamination station	Ea	Contains one 1500 liter water container, 3 foldable 1,000 liter water containers, 2 water pumps, water heater, stower cabin system with tent, hoses, mixers, couplings, and tools.
Belgium	600 liter, French decontamination trailer	Ea	Used to decontaminate large items of materiel.
	U.S. M11 with DS2	Ea	Same utilization as U.S. forces.
	Decontamination apparatus "Portique-Melangeur"	Ea	Has reservoir containing hypochlorite solution into which water is pumped from nearby source. Mixture is sprayed on vehicles through an arch-shaped dissemination device.
	Type I, individual decontamination kit	Ea	Contains 2.8 grams of decontamination powder and blotting paper.
	Type II, individual decontamination kit		Contains 2 fuller's earth decontamination mitts.
Denmark	5 liter decontamination apparatus	Ea	Allocated one for every vehicle over 5 tons.
	Medium, portable decontamination apparatus	Ea	4-10 liter. Allocated 1 per company, 2 per battalion

Table 2-4. Foreign Decontamination Equipment and Agents (Cont'd)

Country	Item	Unit of Issue	Remarks
Denmark (Cont'd)	Skin decontamination kit	Ea	Contains 50 grams of "dutch powder."
Netherlands	STB slurry	Dr	Same as U.S. forces.
	DS2	Cn	Same as U.S. forces.
	Shaker device	Ea	Used to hand-spread dry bleach.
	Backpack sprayer	Ea	Used to spray decontaminants.
	Individual decontamination kit	Ea	Contains 60 grams of "dutch powder" in tubes.
	Sodium carbonate-peroxide mix	Dr	For laundry decontamination of clothing and equipment.
Norway	Individual decontamination kit	Ea	Contains calcium hypochlorite - magnesium oxide powder and fuller's earth pads.
	STB	Dr	Same as U.S. forces.
	DS2	Cn	Same as U.S. forces.
	Benzene or petroleum distillate	Cn	Spray on agent covering alkyed paint, before flushing with water.
Canada	Portable decontamination apparatus	Ea	Weighs 6 lbs, the components include a cylinder for decontaminating agent and nitrogen powered spray assembly. The cylinder contains 1.1 imperial quarts of agent.
	Decontamination mitt	Ea	Issued for decontamination of skin and personal equipment.
Israel	Truck mounted decontamination apparatus	Ea	Capable of road and equipment decontamination.
	M13 decontamination kit, (U.S.)	Ea	Uses both fuller's earth and dutch powder.

Table 2-4. Foreign Decontamination Equipment and Agents (Cont'd)

Country	Item	Unit of Issue	Remarks
Israel (Cont'd)	M11 portable decontamination apparatus (U.S.)	Ea	1 3/4 quart, CO^2 powered, contains DS2. Utilized for decontamination of critical operational areas on vehicles.
	Trailer-mounted decontamination heater	Ea	Utilized for showers and washing contaminated clothing.
	M12 decontamination apparatus (U.S.)	Ea	Used by division-level decontamination units.
Soviet Union/ Warsaw Pact*	IPP decontamination kit	Ea	Individual issue for decontamination of skin and clothing. Contains a nerve gas decontamination solution; a vial with alcohol and chloramine-B for lewisite/mustard decontamination; 4 antismoke ampoules; and gauze pads.
	IPB decontamination kit (Czechoslovak)	Ea	Same as Soviet IPP kit.
	IDPS-69 decontamination set (Soviet only)	Ea	Contains 10 DPS-1 kits and 10 IDP-1 kits and is for weapon or clothing decontamination.
	DPS-1 decontamination kit	Ea	Consists of cloth bag filled with aluminum silicate sorbent and is used on clothing.
	IDP-1 decontamination kit	Ea	One time use. Contains a liquid decontaminant for weapons.
	EP-60 decontamination kit (East German)	Ea	Contains 3 ointments vice liquids for decontamination. One ointment for nerve agent, 1 for blister agents, and 1 for biological and radiological contamination.
	PKhS decontamination kit	Ea	Contains nerve agent decontaminant solution sorbents. This kit is larger than the kits shown above.
	PCHB decontamination kit (Czechoslovak)	Ea	Same as Soviet PKhS decontamination kit.
	DK4 decontamination apparatus, portable	Ea	Consists of a gas-liquid jet pump (with connecting hoses and accessories) operated by vehicle exhaust systems. One kit is authorized per vehicle.

*Soviet Union/Warsaw Pact decontamination items are utilized Pact wide unless specific country is indicated in the item column.

Table 2-4. Foreign Decontamination Equipment and Agents (Cont'd)

Country	Item	Unit of Issue	Remarks
Soviet Union/ Warsaw Pact* (Cont'd)	EEA-64 decontamination apparatus, portable (East German)	Ea	Same as Soviet DK4.
	IZS, EZS, EZCS-34 and EZCZ-54 decontamination apparatus, portable (Poland)	Ea	Variations of the Soviet DK4.
	DKV decontamination systems, portable (Soviet only)	Ea	Used for partial decontamination while troops/ vehicles are on the march. Contains 78-30 liter cylinders prefilled with 2 decontaminant solutions. Operates off compressed air and contains gauges, hoses and brushes. Other Warsaw Pact forces have similar systems.
	DDA-53 mobile decontamination station	Ea	Consists of 2 steam chambers and a steam boiler mounted on a truck. The steam chambers decontaminate clothing, shoes, individual and protective equipment. The steam boiler provides hot water for showers.
	AGV-3M mobile decontamination station (Soviets only)	Ea	Used for clothing and small equipment decontamination. Consists of 4 vehicles; truck mounted steam/hot air generator; 2 truck mounted steam chambers; an equipment truck with a drying tent, shower tent, a collapsible water tank and possibly 2 lime boilers, and other accessories.
	ARS-12U and ARS-14 vehicle-mounted decontamination tanks	Ea	ARS-12U has 2,500 liter tank mounted on truck. ARS-14 has 2,700 liter tank mounted on a heavier truck. The vehicles have pumps, hoses and brushes.
	IRS (Poland) and ARS-12M (Czechoslovak) vehicle-mounted decontamination tank	Ea	These units are similar to the Soviet ARS-12U except that each has a water heater for cold weather operation.
	DDA personnel decontamination station	Ea	Consists of 3 interlocking tents serviced by 2 DDA 53 units, and contamination check points. The center tent contains the shower unit.
	TMS-65 rapid decontamination vehicle (Soviet)	Ea	Consists of a jet engine mounted on a truck with 2 1,500 liter tanks (1 for water/decontaminant, and the other for jet engine fuel). The vehicle also has a smoke screen production capability.

*Soviet Union/Warsaw Pact decontamination items are utilized Pact wide unless specific country is indicated in the item column.

Table 2-4. Foreign Decontamination Equipment and Agents (Cont'd)

Country	Item	Unit of Issue	Remarks
Soviet Union/ Warsaw Pact* (Cont'd)	TZ-74 rapid decontamination vehicle (Czechoslovak)	Ea	Similar to Soviet TMS-65 except for different jet engine, a 5,000 liter water tank, 2,000 liter fuel tank. The operator's cabin is insulated and has NBC collective protection system.
	WUS rapid decontamination vehicle (Poland)	Ea	Similar to TMS-65 and TZ-74. Fuel and water tanks are 1,800 liter and the operator's cabin is a plastic bubble on the top of the vehicle cabin.
	Decontaminants		
	DT-1, monochloramine -B	Ea	For decontamination of skin, clothing and equipment (blister agents). Noncorrosive.
	DT-2, dichloramine -B	Ea	For decontamination of metal surfaces (blister agents). Noncorrosive.
	DT-2T, dichloramine -T	Ea	For decontamination of wooden and metal surfaces (blister agents). Noncorrosive.
	DT-6, hexachloromelamine	Ea	For decontamination of vehicles, weapons, equipment and terrain (blister and nerve agents). Corrosive.
	Decontaminants		
	DTS-GK (aqueous slurry)	Ea	For decontamination of vehicles, weapons, equipment and terrain (blister and nerve agents). Corrosive.
	Ethanolamine	Ea	For decontamination of vehicles, weapons, equipment, structures and terrain (nerve agents). Used in Soviet decontamination solution No. 2.
	SF2 detergent	Ea	For decontamination of vehicles, weapons, equipment, materials and terrain (radiological contamination).
	Sodium carbonate	Ea	For decontamination of clothing (blister and nerve agents).
	Decontamination Solutions		
	Decontamination solution No. 1	Ea	For decontamination of vehicles, weapons, equipment, structures and terrain (blister and V-type agents).
	Decontamination solution No. 2	Ea	For decontamination of vehicles, weapons, equipment, structures and terrain (G-type agent).
	EFI-I (East German)		For decontamination of vehicles, weapons, equipment, structures and terrain (blister agents).
	EFI-II (East German)		For decontamination of vehicles, weapons, equipment, structures and terrain (nerve agents).
	EFI-III (East German)		For decontamination of vehicles, weapons, equipment, structures and terrain (blister and nerve agents).

*Soviet Union/Warsaw Pact decontamination items are utilized Pact wide unless specific country indicated in the item column.

Table 2-5. United States Decontamination Equipment and Agents

Country/service	Item	Unit of Issue	Cost	Allocation	Cube/weight (lb)	Table of authorized Material (TAM) NR	Remarks
United States US MARINE CORPS Standard USMC decontamination items	M13 decontamination kit	EA	$ 1.03	1 per individual	2.24/70 per 100	C2065	Used for clothing/equipment/weapons.
	Super tropical bleach (STB)	DR	39.15	1 or more per unit	1.40/61	C2070	50 gallon drum. Quantity varies with mission mobility of the unit.
	M11 decontamination apparatus	EA	39.74	1 per vehicle/weapon over 105 MM/5 per squadron	3.00/61 per 12	C2080	CO_2 cartridge powered 1½ quart. Uses DS2 in 1 1/3 quart containers
	M258 skin decontamination kit	EA	2.70	1 per individual	2.82/34 per case	C2205	Skin decontamination (less face) 2 solutions.
	M12A1 decontamination apparatus	EA	10,266.00	1 per battalion/squadron	15.86/2560	B0465	Includes tank unit, shower assembly, pump/hose unit and water heater.
	Decontamination slurry antisetting compound	CN	17.45	1 or 2 per specified unit	1.30/125	K4000	Used in M12A1 to prevent the formation of solids in slurry.
	Decontamination solution number 2 (DS2)	CN	6.50	Varies per unit	1.40/42 per 12	K4265	1.3 quart can. Unit quantity varies according to mission.
	DS2	DR	103.00	Varies per unit	1.10/45	K4270	5 gallon drum. Unit quantity varies with mission.
Standard items which have decontamination capabilities	Truck, firefighting ¼ ton, 4x4, MC1051*	EA	est. 9,000.00	Based on airfield size for FMF	372/3849	D1080	Motor transport item.
	Truck, firefighting, brush, M530C*	EA	49,972.00	Based on airfield size for FMF	1663/18440	D1084	Motor transport item.
	Truck, firefighting, structural, 530C*	EA	41,612.00	Based on airfield size for FMF	1663/18820	D1085	Motor transport item.
	Truck, tank, water 1,000 gal., M50A2*	EA	12,388.00	Based on airfield size for FMF	1462/14750	D1120	Motor transport item.
	Truck, crash, fire, rescue M1000*	EA	120,000.00	Based on airfield size for FMF	2304/39440	D1062	Motor transport item.
	Truck, crash, fire, rescue MB1*	EA	130,000.00	Based on airfield size for FMF	2394/22500	D1065	Motor transport item.
	Truck, crash, fire, rescue, 4x4, MB-5*	EA	85,000.00	Based on airfield size for FMF	1848/14790	D1066	Motor transport item.

*FMF truck allocations based on minimum response requirements for airfield operations. These requirements are the number of gallons of water needed for aircraft fires based on the takeoff weight of aircraft normally assigned to the airfield.

Table 2-5. United States Decontamination Equipment and Agents (Continued)

Country/service	Item	Unit of Issue	Cost	Allocation	Cube/weight(lb)	Table of authorized Material (TAM) NR	Remarks
UNITED STATES US MARINE CORPS Standard items which have decontamination capabilities	Bath unit, trailer mounted, EC-88-64	EA	15,000.00	16 Division 14 Wing	536/5224	B0060	Engineer item located in engineer battalions/squadrons.
	Drum, fabric, collapsible, liquid fuel, 500 gallon	EA	2,700.00	112 FSSG	26/365	B0570	Engineer item located in engineer battalions/squadrons.
	Fuel system amphibious assault, 600,000 gallon M69H	EA	1,063,636.00	12 FSSG	11135/140164	B0685	Engineer item located in engineer battalions/squadrons.
	Helicopter expedient refueling system	EA	16,000.00	18 Wing	505/6134	B1135	Engineer item located in engineer battalions/squadrons.
	Laundry unit, trailer mounted, M532	EA	15,000.00	24 Division 12 Wing	1056/8970	B1225	Engineer item located in engineer battalions/squadrons.
	Tank, collapsible 3,000 gallon	EA	4,000.00	100 FSSG 55 Wing	42/617	B2130	Engineer item located in engineer battalions/squadrons.
	Water distribution equipment	EA	2,100.00	18 FSSG	79/2411	B2600	Engineer item located in engineer battalions/squadrons.
	Water purification equipment sets 1500 GPH	EA	15,000.00	7 Wing	1718/24300	B2605	Engineer item located in engineer battalions/squadrons.
	Water distribution equipment set M62	EA	2,600.00	18 Wing	51513/3520	B2610	Engineer item located in engineer battalions/squadrons.
	Water purification set, 600GPH, trlr mtd, U2200	EA	6,500.00	11 Wing	777/5500	B2620	Engineer item located in engineer battalions/squadrons.
	Water purification unit frame mounted, 1500GPH U22446	EA	4,460.00	18 FSSG 21 Wing	21/775	B2625	Engineer item located in engineer battalions/squadrons.
	Pump, rotary, deep well	EA	4,000.00	15 per Eng spt bn FSSG	80/1447	U3240	Engineer item located in engineer battalions/squadrons.
US ARMY	M13 decontamination kit	EA	N/A	1 per ind, +10% for training	N/A	N/A	Same as USMC Remarks.
	STB	DR	N/A	1 per co/btry/troop	N/A	N/A	Same as USMC Remarks.
	M11 decontamination apparatus	EA	N/A	1 per vehicle trailer or towed crew served weapon	N/A	N/A	Same as USMC Remarks.
	M258 skin decontamination kit	EA	N/A	2 per individual	N/A	N/A	Same as USMC Remarks.
	M12A1 decontamination apparatus	EA	N/A	9 per division 6 per NBC Co.	N/A	N/A	Same as USMC Remarks.

Table 2-5. United States Decontamination Equipment and Agents (Continued)

Country/service	Item	Unit of Issue	Cost	Allocation	Cube/weight (lb)	Table of authorized Material (TAM) NR	Remarks
UNITED STATES US ARMY	Decontamination slurry antiset compound	CN	N/A 13.00	1 or 2 per specified unit	N/A 1.3/54 per 4.12/5 lb can	N/A	US Army allocation similar to US Marine Corps.
	DS2 1 1/3 qt. 5 gal	CN DR	N/A 7.63 103.00	2 per M11 2 per co/btry/trp	N/A 1.10/45- 20/120	N/A	Same as USMC Remarks.
US NAVY	M13 decontamination kit	EA	N/A 1.03	1 per individual	224/70 per 100	N/A	Same as USMC Remarks.
	Antiset compound M2	CN	N/A 13.00	1 can for each 25 drums of STB	1.3/54 per 412.5 lb can	N/A	12.5 lb. can, shore activities. To be added to STB slurry to prevent formation of solids.
	Alcohol, isopropyl, NF	DR	N/A 17.59	3 gl. per every 100 shore personnel plus, 10 gl. for every 100 personnel engaged in disaster control	1.0/39	N/A	5 gallon can, shore activities. Used for personnel biological decontamination when showers not available.
	DS-2 Decontamination Solution	CN	N/A 7.63	5 per ea. M11	1.4/3.1 per 12	N/A	1 3/4 qt. can, shore activities.
	Super Tropical Bleach (STB)	DR	NA 39.15	CONUS-400 lb for ea acre of operational area, outlying area 1200 lb for each acre	1.4/61	N/A	50 lb. drum, shore activities.
	Detergent, wetting agent	DR	Not available	One drum for each 320 drums of STB	7.6/212	N/A	200 lb. drum, shore activities. Used to assure complete wetting of surfaces.
	Formaldehyde solution and methanol Formaldehyde Methanol	 DR CN	N/A 93.60 12.98	1 gal. formaldehyde for every 4,000 CF of building space	 7.5/5001 1.2/38	N/A	55 gal. drum when a mixture of both. 5 qts. 5 gal. can of formaldehyde and 3 qts. methanol for every 10,000 cub. ft. Used to biological decontaminate interior of buildings and equipment.
	Sodium metabisulfite	DR	.78 per lb.	For 1,000 men per day for 7 days 20 lbs.	1.2/30	N/A	25 lb. drum. Used to dechlorinate water after biological decontamination by chlorination.
	M11 decontamination apparatus	EA	N/A	One per automotive vehicle	3.00/61 per 12	N/A	USMC Remarks pertain.

Table 2-5. United States Decontamination Equipment and Agents (Continued)

Country/service	Item	Unit of Issue	Cost	Allocation	Cube/weight	Table of authorized Material (TAM) NR	Remarks
UNITED STATES US NAVY	M12A1 decontamination apparatus	EA	N/A 10,266.00	CONUS-1 per 10-300 acres of operational area plus, 1 for each additional 300 acres. Outlying areas, 1 per 10-150 acres.	15.86/2560	N/A	USMC Remarks pertain. Each mobile construction battalion rates two.
	Generator, fog, insecticidal, 40GPH	EA	1,839.00	1 per each activity having large structures	59/900	N/A	Dissiminate formalin fog to decontaminate building interiors.
	Sprayer, insecticidal, portable EMD	EA	73.53	1 per bldg. space up to 100,000 CF plus 1 for an additional 100,000 CF, Max auth.-5	85/13	N/A	1 galion, with electric timer. Used to decontaminate small rooms with formalin/insecticide vapor.
	Dispenser, ethylene oxide M10	EA	1.66	1 per each member of disaster team, plus overall allowance of 5%	[illegible] per box of 24	N/A	12 oz. pressurized can. Used to decontaminate clothing/equipment in conjunction with the polyethylene bag.
	Gasproof bag polyethylene	EA	.29	1 per each member disaster team, plus overall allowance of 5%	2.2/57 per box of 24	N/A	Used in conjunction with the ethylene oxide dispenser to decontaminate clothing and equipment.
	M13 decontamination kit	EA	1.01	1 per individual	2.25/70 per 100	N/A	Mobile Construction Battalion Allowance.
	Bag, gas proof	EA	.29	2 per individual	2.2/57 per box of 100	N/A	Mobile Construction Battalion Allowance
	Dispenser, oxide, M10	CN	1.66	1 per individual	.01/1	N/A	Mobile Construction Battalion Allowance

Table 2-5. Unites States Decontamination Equipment and Agents (Continued)

Country/service	Item	Unit of Issue	Cost	Allocation	Cube/weight	Table of authorized Material (TAM) NR	Remarks
UNITED STATES US NAVY	M3 impregnating set, clothing	EA	31.65	70 per Bn	210/3500	N/A	Mobile Construction Ba talion Allowance
	M11 decontamination apparatus 1½ quart	EA	39.74	40 per Bn	6/240	N/A	Mobile Construction Battalion Allowance
	Methyl alcohol	DR	10.11	14 per Bn	14/700	N/A	Mobile Construction Battalion
	Formalin	DR	93.60	2 per BN	24/1016	N/A	Mobile Construction Battalion, 55 gallon drum
	Carboxide Gas	CYL	60.50	4 per BN	12/240	N/A	Mobile Construction Battalion. 60 pound cylinders
	STB	DR	28.29	66 per Bn	66/3300	N/A	Mobile Construction Battalion
	M2, antiset slurry	CN	13.00	2 per Bn	.25/25	N/A	Mobile Construction Battalion
	DS-2 decontamination solution	CN	7.63	120 per Bn	20/120	N/A	Mobile Construction Battalion, 1½ quart
US AIR FORCE	M13 decontamination kit	EA	N/A 1.03	1 per individual.	N/A 2.24/70 per 100	N/A	Same as USMC Remarks
	Super tropical bleach (STB)	DR	N/A 39.15	Determined by local commander	N/A 1.40/61	N/A	Same as USMC Remarks
	M11 decontamination apparatus	EA	N/A 39.74	1 for each tactical vehicle, aerospace equipment	N/A 3.00/61 per 12	N/A	Same as USMC Remarks
	M12A1 decontamination apparatus	EA	N/A 10,266.00	2 per base in Europe, additional as required	N/A 15.86/2560	N/A	Same as USMC Remarks
	DS-2	CN	N/A 7.63	Determined by local commander	N/A 1.10/45	N/A	Same as USMC Remarks
	M258/258A1 decontamination kit	EA	N/A 2.70	1 per individual	N/A 2.82/34 per case	N/A	Same as USMC Remarks

shown in table 2-6, should provide the Marine Corps planner with data for insertion into ongoing five-year program objectives management (POM) cycle.

2.2.4 Tools and techniques of analysis.

The methodology used during the course of this study to determine decontamination requirements included:

- Pragmatic assessment of operational plans, after-action reports, relevant studies, organizational and doctrinal publications, and concepts of operations.
- Experiential assessment was used where there was no formal publications on which to determine acceptance of a procedure.
- Intuitive judgement was utilized when neither published information nor applicable experience provided guidance to assess values or situations.
- Inductive reasoning developed the premises, concepts and conclusions of this study.
- Deductive reasoning provided information on the components and causes of the overall result, and was used extensively in analyzing the results of the wargame simulation of the CAT.

2.3 LEVELS OF DECONTAMINATION REQUIRED

2.3.1 General. Establishment of decontamination levels for the MAGTF must include the consideration of individual (including personal equipment and clothing), unit equipment and large area requirements.

2.3.2 Individual decontamination levels.

2.3.2.1 Nuclear decontamination.

- Early decontamination is necessary to reduce the cumulative effects of radiation. Since radioactive material cannot be

Table 2-6. Developmental Decontamination Items

Item	Cost
Decontamination apparatus XM13. Portable 14 liter capacity, vehicle-mounted, man-portable, manually operated.	$ 130.00 each
Decontamination apparatus XM14. Power drive, truck mounted product improvement of M12A1 power driven decontamination apparatus (PDDA).	Not available
Decontamination apparatus, XM16, truck mounted, jet-exhaust.	Not available
Personnel equipment decontamination system (PEDS).	Not available
Decontamination apparatus XM15, interior surface.	Not available
IME/Norwegian NBC Sanator XM17, (lightweight decontamination system).	$13,700.00 each
Navy/Marine Corps portable shower-laundry facility.	$15,000.00 each shower with boiler. $150,000.00 each laundry.
Sacrifical coating for painted surface decontamination.	$10.00 per gallon of coating material. $3.00 per pound of removal solution.
Thin film flakes for hazardous material immobilization.	Under $300 per hectare of terrain covered.

destroyed or neutralized, it must be physically removed from an individual's skin, clothing, equipment, position, and food as listed below:

- •• Skin. Skin is normally decontaminated by bathing; however, if bathing is not possible, exposed skin should be wiped gently with a damp cloth, and dust should be removed from hair and from under fingernails.
- •• Clothing. Clothing decontamination is accomplished by removal of clothing or vigorous shaking or brushing of clothing.
- •• Equipment. Equipment decontamination can be reduced by covering items before fallout occurs (contamination avoidance). Washing with water is an effective method of radiological decontamination.
- •• Position. Decontamination of individual positions accomplished by sweeping or scraping away contaminated soil. Foxholes are decontaminated by removing approximately one-half inch of soil from sides and bottom.
- •• Food and water. Food and water that is sealed or packaged is decontaminated by washing and scrubbing before opening. Contents should be also tested for secondary chemical/radiological contamination.

2.3.2.2 Biological decontamination. Individual decontamination procedures include:

- Delousing procedures.
- Use of insect repellents.

- Washing contaminated clothing in hot soapy water or airing in sun.
- Showering with germicidal soap when available.

2.3.2.3 Chemical decontamination.

Individual chemical decontamination is performed within 1 minute of contamination and is classified as emergency decontamination. Emergency decontamination consists of the individual using the M258 decontamination kit to remove or neutralize chemical agents on the skin. The M258 kit will be used for all skin decontamination except the eyes which must be flushed with water repeatedly.

Partial chemical decontamination consists of those actions taken by individuals in MOPP Level 1 or 2 to decontaminate clothing and personal weapons which require handling to function or operate. Partial decontamination must be accomplished within 15 minutes of being contaminated to prevent agent penetration.

Limited decontamination for individuals include actions taken as soon as possible by personnel to decontaminate critical areas of their crew-served weapons, fighting vehicles, aircraft, and equipment to permit continued combat operations.

2.3.3 <u>Unit decontamination levels</u>.

2.3.3.1 Radiological decontamination. Unit radiological decontamination includes the actions previously stated for individuals.

2.3.3.2 Biological decontamination. Unit decontamination procedures are the same as individual biological decontamination. Methods to minimize the effects of biological contamination before they occur include having in effect an immunization program and implementation of proper hygienic procedures.

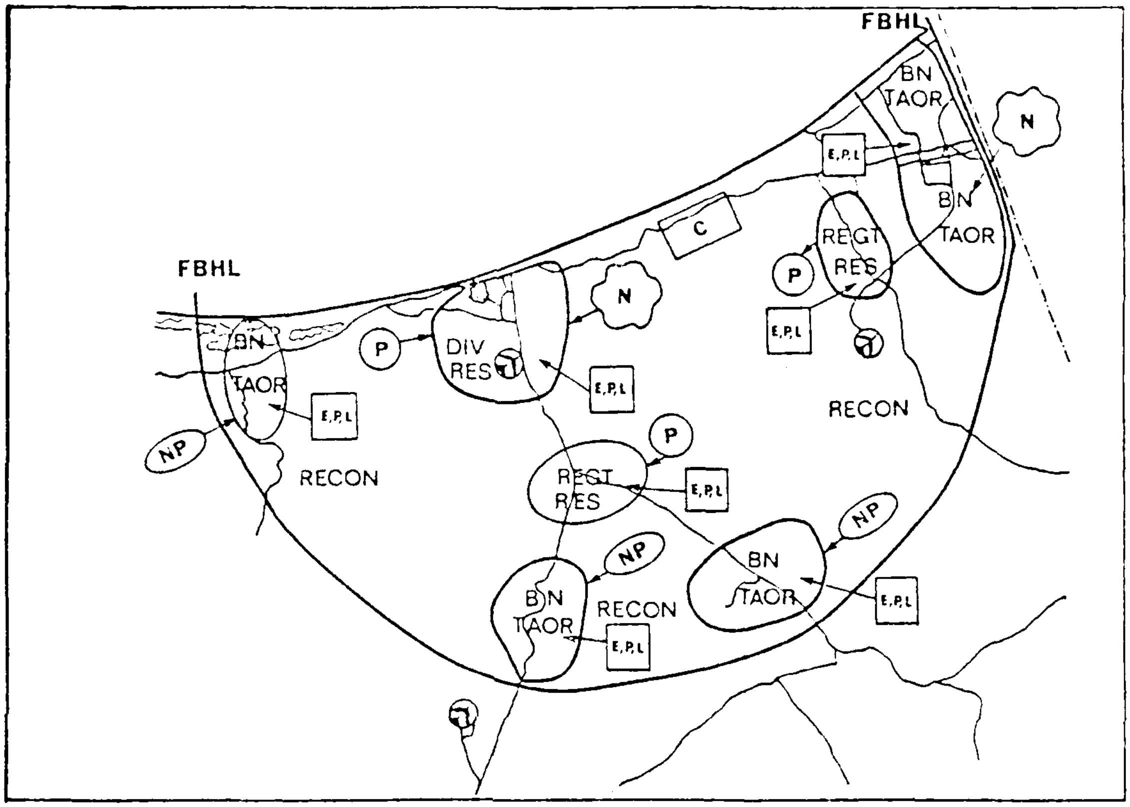
2.3.3.3 Unit chemical decontamination. Unit chemical decontamination is an organized effort performed by personnel of the command, with organic equipment, when directed by the commander. There are two types of unit chemical decontamination: limited decontamination of an organization's equipment to further reduce contamination levels of organic equipment, and complete decontamination. Complete decontamination of individuals and equipment will occur when the tactical situation permits the establishment of personnel decontamination stations (PDSs) and equipment decontamination stations (EDSs) by trained decontamination personnel. Complete decontamination requries a clean area, is time consuming, and requires excessive amounts of water. See figure 2-5 for a schematic decontamination requirements in an FBH.

2.3.3.4 Large area decontamination requires extensive manpower, materials and time, and should be avoided unless absolutely necessary. If required, large area decontamination will be accomplished by support/service support organizations (for example, FSSG/division engineer battalions and wing engineer squadrons).

2.3.4 <u>Combat/combat support unit</u>.

Combat/combat support units should be responsible for emergency and partial decontamination of personnel and limited decontamination of the unit equipment to reduce contamination to a level which ensures mission accomplishment.

Since most combat/combat support units operate in the forward battle area the chemical hazard is primarily NP. Emergency, and limited decontamination procedures, will allow operation in protective masks only. NP does not normally present a serious percuteaneous.



LEGEND

Contamination
N--Nuclear
NP--Nonpersistent chemical
P--Persistent chemical

Decontamination
E--Emergency
P--Partial
L--Limited
C--Complete*

*Complete decontamination requires a clean environment and extensive water source.

Figure 2-5. Schematic of Types of Field Decontamination

The data from the Dugway report further substantiates that combat/combat support units operating near the FEBA need not perform complete decontamination in order to accomplish their mission in an NP/blood agent environment.

Combat/combat support units operating to the rear of the main battle area (artillery, armor, and infantry reserve areas) will be subjected to P and mustard (M) agent contamination which will require operations to be conducted in mission-oriented protected posture 4 (MOPP4) and personnel perform emergency, limited, and partial decontamination procedures to reduce the hazard.

When the Dugway data are considered P hazards (under temperate conditions) will be significantly reduced within one hour to where personnel can wear masks and gloves only. After 2 hours, P agents will pose no militarily significant threat to personnel.

If the degree of contamination is maintained by repeated strikes, the effects are cumulative and the resultant incapacitation and lethal dosages can require continued operations in MOPP4 and emergency, limited and partial decontamination procedures will be used until the mission is accomplished or until time and resources allow complete decontamination. Whenever possible, combat/combat support units should move out of the contamination area.

2.3.5 Combat service support units.

Normally, combat service support units will be located far enough behind the FEBA to be targeted with P and M agents. Since these units are equipment and material intensive, they cannot easily move away from contamination and must decontaminate to survive. Again, emergency, limited, and partial decontamination must be performed immediately after a chemical attack to permit continuance of the support mission. When the situation, personnel,

and time allows, complete decontamination will be conducted. This is especially true for units contaminated by M agents. Specialized equipment for complete decontamination will be authorized in unit tables of equipment (T/Es).

2.3.6 Aviation unit.

Aviation units will normally be located to the rear of the main battle area (MBA) and will be subjected to P and M hazards. The aircraft will become contaminated if not under cover, and will require decontamination. Aircraft will also become contaminated from contact hazards while taxiing, taking off, landing, and flying through agent(s). Primary NBC hazards to aircraft are more likely to occur when the aircraft are taxiing or are stationary at an airbase. Aircraft flying through agent clouds will receive contamination; however, the friction created by flying and the weathering process will significantly reduce the hazard (90 percent of contact hazard). This is especially true with high performance aircraft. The remaining 10 percent will be in tires, screw threads, and panel seals.

Contamination of the runways, terrain, and ground support equipment presents the aviation unit with the requirement for all four types of decontamination. Individuals must decontaminate themselves, their equipment, and critical equipment areas by emergency, limited, and partial decontamination procedures. When the situation permits, complete decontamination of terrain, equipment, and aircraft will be conducted.

According to the Dugway data, if chemical contamination levels are not maintained by repeated strikes, the requirement for complete decontamination may be negated. Complete decontamination of N and P (including thickened) would not be required because of the increased evaporation presented. However, M agent contamination requires complete decontamination.

2.4 CURRENT FMF DECONTAMINATION CAPABILITIES

2.4.1 Overview. The current capability of the FMF to conduct effective decontamination operations is at best marginal. The current decontamination doctrine as presented in FMFM 11-1 is based on U.S. Army doctrine which identifies individual, unit and support decontamination, as discussed on pages 2-10 and 2-11, which is, in many cases, inappropriate for MAGTF units. These procedures include emergency, limited, partial, and complete decontamination previously discussed in sections 2.1 and 2.2 and are based on the assumption that every unit has the personnel, equipment, and resources to conduct all levels of decontamination operations. This is not a viable concept for MAGTF forces in contact with the enemy that cannot stop mission accomplishment to conduct complete decontamination. The current requirement to have a large decontamination apparatus at the infantry and artillery battalion is not practical for MAGTF combat units. The decontamination equipment which is authorized was developed for U.S. Army use and is not well suited for FMF needs. Most of this equipment, with the exception of individual decontamination kits, is ageing, available in inadequate numbers, and at the wrong organizational level to meet the requirements of the FMF.

2.4.2 Equipment.

The Marine Corps table of authorized material (TAM) includes the following decontamination equipment and decontaminants:

- M13 kit--for decontamination of the individual and personal equipment. Allocated one per individual.
- M258 kit-for personnel decontamination. Allocated one per individual.

- M11 1½ quart decontamination apparatus--for weapons over 105mm. Allocated one per weapon and five per aircraft squadron.
- M12A1 power driven decontamination apparatus (PDDA). Allocated one per battalion or squadron.
- Super tropical bleach (STB). Issued in various quantities which depend on the type of unit.
- Decontamination solution number 2 (DS2). Issued on various quantities to accomplish the mission.

2.4.3 <u>Current decontamination equipment/agent deficiencies and needs</u>. Current decontamination equipment is inadequate to fully meet the Marine Corps' unique amphibious operations requirements.

- The individual decontamination kits, M13 and M258, provide a satisfactory capability which will be greatly enhanced by the product improved M258A1 (wet towelettes vice vials of liquid solution). There is a further requirement for larger, dry decontamination mitts and towelettes for individual, personal clothing, equipment and weapons, and casualty decontamination. The current allocation of M13 and M258 kits is satisfactory and should not be modified.
- The M11 decontamination apparatus does not contain enough DS2 to adequately reduce the hazards to critical areas of crew-served weapons and vehicles.
- The M12A1 PDDA is difficult to maintain, transport, and set up in an amphibious environment where prime movers are at a premium and cannot be dedicated to NBCD.

- There is a critical requirement for a contamination monitor which can detect and display levels of chemical contamination so personnel can distinguish when decontamination operations have reduced the hazard to a militarily acceptable level.
- The current decontamination agents STB and DS2 are corrosive to many metals and as a result have a limited capability. Therefore, these agents cannot be used on aircraft or electronic equipment.

2.4.4 Personnel.

The current Marine Corps NBC specialist allocation includes the following personnel:

- At least one noncommissioned officer in each battalion or squadron.
- Two warrant officers and 35 enlisted are on T/O 1988, headquarters battalion, Marine division to provide staff cognizance, establish an NBC control center, and provide personnel for six decontamination/detection teams.
- One warrant officer and 34 enlisted are on T/O 3449, headquarters and service battalion, FSSG to provide the same functions as shown for division; except that there are only three decontamination/detection teams.
- The wing headquarters squadron, T/O 8611, is allocated a lieutenant (additional duty 1), 1 warrant officer, and 27 enlisted to provide staff functions, wing control center staff, and five decontamination/detection teams.
- An NBC specialist NCO is at each Marine Corps logistic support base.

- Selected organizations, such as MCDEC, and the tank battalion at the Marine Corps air-ground combat center each have warrant officers assigned.

At present, the allocation and grade structure for NBC specialists is being revised by HQMC, and new personnel to fill the warrant officer and enlisted billets are in the pipeline.

2.4.5 Training.

Marine Corps Order (MCO) 1500.40 establishes the types, location, and categories of training for Marines. NBC defensive (NBCD) training parallels the organization for training stated in that MCO to include the following:

- Mission-oriented training. Normal USMC training includes NBCD factors (that is, defense against target acquisition, field sanitation, field fortifications, camouflage, and first aid).
- Individual Marines are required to be trained in the concepts of NBCD in order to survive and perform assigned missions. This training is given either in a school or unit environment.
- Units are required to be trained in collective standards of NBCD proficiency to prepare two or more Marines (crews, teams, squads, platoons, and so forth) to accomplish group tasks.
- NBCD training, either individual or collective, conducted in the formal school environment and utilizing approved Programs of Instruction (POI) is considered institutional training. The U.S. Army Chemical School at Fort McClellan, Alabama provides this training for Marines whose primary military occupational specialty (MOS) is in occupational field (OccFld) 57 (NBC).

- Command-sponsored NBC schools, such as the Fleet Marine Force, Atlantic (FMFLANT) NBC school, provide NBCD training to develop specialists to perform specific NBC duties on an additional duty basis. These schools are not considered formal schools.
- Unit NBCD training covers all NBCD training conducted in a unit, including both individual and collective training.
- NBCD specialized skill training is that training which provides officer and enlisted personnel with NBCD skills and knowledge to perform specific NBCD jobs.
- NBCD initial skill training is that NBCD training undertaken by each Marine subsequent to recruit or officer acquisition training to initially qualify for a basic 5700 MOS (5711 for enlisted, 5702 for warrant officer).
- Marines making a lateral move into the 5700 field also undergo specialized skill training.
- NBCD skill progression training is that training received subsequent to initial skill training which provides a Marine with additional skills and knowledge in the 5700 field to allow proper performance at a higher skill level or in a supervisory position. There is currently no course beyond the basic NBC OFF/EN listed in the USMC school catalogue.
- Functional training incorporates the specific NBCD skills required by unit members other than those with a primary 5700 MOS so they can perform, on an additonal duty basis, unit mission-oriented NBCD objectives such as monitor/surveillance, decontamination, control and assessment operations, as well as operate NBC control centers and nuclear detonation (NUDET) observation posts.

- NBCD team training. The NBCD teams identified in table 2-7 have varying training goals dependent on their parent organization. To meet these goals, different programs and methods are necessary; additionally, differing tasks, conditions, and standards may apply.

Table 2-7. Nuclear, Biological, and Chemical Defense Teams

LEVEL NUDET TEAMS	MONITOR/ SURVEY TEAMS	DECON TEAMS	CONTROL CENTER TEAM	CONTROL & ASSESSMENT TEAMS	NUDET TEAMS
Company	X				
Battalion	X	X	X	X	
Regiment	X	X	X	X	
Division	X*	X*	X*	X	X
Squadron	X	X	X	X	
Group	X	X	X	X	
Wing	X*	X*	X*	X	X
FSSG	X*	X*	X*	X	
MAU					
MAB					
MAF					

Note:

*Specialized NBC teams located at Division, Wing, and FSSG headquarters provide formally trained personnel to augment subordinate commands as required.

- Decontamination teams are organized at the following specified levels of command: battalion, squadron, and FSSG. It is desirable that all members of these teams be school-trained; but,

as a minimum, the noncommissioned officer (NCO) are required to be so trained. Personnel trained in decontamination are required to be able to accomplish the following tasks:

- •• Perform necessary decontamination of supplies, equipment, and areas for which they are responsible in the performance of their primary duties.
- •• Operate and maintain assigned decontamination equipment.
- •• Establish and operate a personnel decontamination station.
- •• Take actions, where possible, to avoid the spread of contamination.

- These decontamination teams are required to be school-trained either at the command-sponsored NBC school or at the U.S. Army Chemical School.
- The squadron and battalion are required to utilize trained decontamination team personnel on an additional duty basis since complete decontamination is conducted only if time, personnel resources, and mission accomplishment allow.
- The division, wing, and FSSG decontamination teams consist of personnel trained at the U.S. Army Chemical School who are assigned to the decontamination team on a full-time basis.
- The current training emphasizes that Marines must become acclimatized to wearing protective clothing while performing assigned missions. This is especially true for decontamination teams that wear impermeable rubber suits during operations. The teams are required to learn to cope with the physiological, psychological, and physical stress of encapulation in NBC protective clothing/ equipment. Generally, working in the

heat for 2 hours a day for 7 days will permit up to 95 percent heat acclimation.

- Special NBCD training for aircrews requires flying (training) with above-the-neck equipment every 6 months. The training philosophy is to acclimate aircrews to keep going until crew day is reached.

2.5 DEVELOPMENT OF DECONTAMINATION AREAS

2.5.1 Decontamination agents.

There are several decontamination agents being developed that may fill the requirement for an improved non-caustic agent which can be used on items of equipment. One of these is the West German emulsion, a decontamination agent that neutralizes contaminants and leaves no toxic residue. This emulsion is a standard item for Federal Republic of Germany forces. It has been tested by Dugway Proving Ground and appears to warrant further investigation by the Marine Corps.

The Los Alamos Scientific Laboratory is experimenting with the use of a laser to decompose organophosphorus compounds; however, the design of a decontamination laser capable of field operations has not been undertaken at this time.

An experimental method of decontamination now being investigated by MCDEC is the corona discharge system which repels biological agents and breaks down chemical compounds by exposure to electrical fields.

Dual-purpose decontamination methods currently under investigation and/or development are:

- ASH (activated solution of hypochlorite) and SLASH (self-limiting ASH) solutions.

- Steam/hot water decontamination systems.
- Jet-exhaust decontamination systems.

The ASH and SLASH systems are Naval Research Laboratory (NRL) developments while the steam, hot water, and jet exhaust systems are being developed by the U.S. Army CSL. In addition, a Civilian industry is also investigating potential new agents for decontamination which could fill the need for a universal decontaminant that can be easily fielded.

2.5.2 Contamination avoidance.

Several items are under investigation in the area of contamination avoidance, those which have been tested and offer some promise are listed below:

- The Naval Explosive Ordnance Disposal Facility (NAVEODFAC) has conducted experiments into the use of sacrificial coating (developed by a contractor) to remove agents GD, thickened GD (TGD), VX, and HD from painted metal surfaces. Initial results indicate that application of the coating greatly reduces the vapor concentration immediately for all agents tested. This development should be further investigated.
- Another development by NAVEODFAC which appears to have merit and should be monitored, is the use of thin film flakes for hazardous material immobilization. This method of decontamination (actually contamination avoidance) uses a thin mat of ultrathin polymer film flakes applied on a surface to prevent short-term reaerosolization of toxic, hazardous particles. Further experimentation is required to refine the concept, but it appears to have potential to rear-area installations, particularly airfields. The estimated cost of this method is about $300 per hectare.

- CSL, the U.S. Army Test and Evaluation Command, the U.S. Army Aviation Development Test Activity, and DPG, have conducted tests of polyurethane (chemical agent resistant) paint (PUP). These tests have shown PUP to be superior to alkyd enamel paint in the area of durability. Generally, after decontamination, PUP retained less chemical agent than alkyd paint.

2.5.3 Decontamination equipment.

Decontamination equipment is being primarily developed by CSL for all the Services, but specific requirements are being investigated by the individual Service.

The Marine Corps, through MCDEC, is funding development of a decontamination system for electronic and other items easily damaged by decontaminants which uses hot air and the corona discharge principle. There is also another application of the corona discharge which includes the use of dust that may be useful as a method of personnel decontamination.

The Navy-Marine Corps shower unit being developed at the U.S. Navy Civil Engineering Laboratory, Port Hueneme, California, figure 2-6, may be satisfactory, as a part of the decontamination process for personnel.

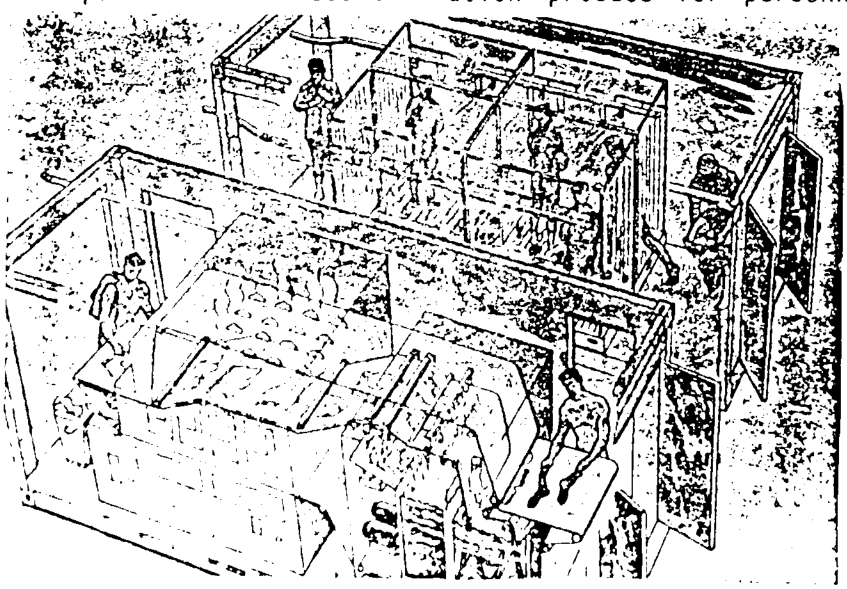


Figure 2-6. Navy Marine Corps Laundry and Shower Unit

CSL is developing/evaluating six decontamination items as the Department of Defense (DoD) executive agent for Joint-Service NBCD development.

- The XM13 portable decontamination apparatus is being designed to dispense standard decontaminating solution. It consists of a prefilled decontaminating agent container, a manual pump, a hose, two wand sections, a detachable brush, and weighs approximately 60 pounds. It is designed to be vehicle-mounted, man-portable, manually operated, and easily maintained. It is used on wheeled and tracked vehicles, construction equipment, towed and self-propelled artillery, and crew-served weapons larger than 60 caliber. The first production delivery of this item (to the U.S. Army) is projected for February 1983. The projected cost per unit is $130. Figure 2-7 shows a prototype model.
- The XM14, truck-mounted, PDDA is an improvement of the current M12A1 which provides permanent mobility, a more reliable power source, a steam cleaning capability, and a vehicle wash/rinse rack. This apparatus would provide vehicle-/equipment-intensive organizations and NBCD units with mobile decontamination assets. The Army's Initial Operating Capability (IOC) date is December 1984. The projected cost cannot be determined since the requirement is being completely revised. Figure 2-8 shows this projected vehicle-mounted decontamination apparatus (VMDA).
- The XM16 truck-mounted, jet exhaust, decontamination system consists of J60 jet engine, control cab, and modular control unit mounted on a turntable at the rear of a 5-ton truck. A

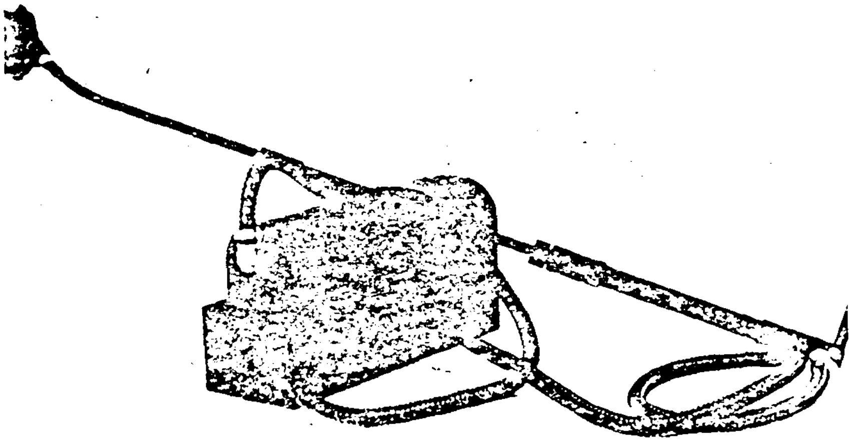


Figure 2-7. Prototype XM13

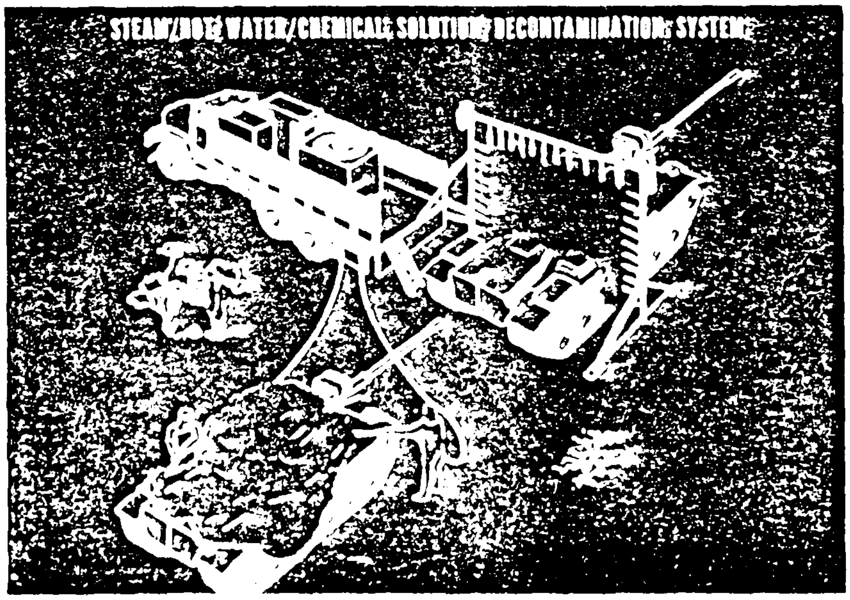


Figure 2-8. XM14 VMDA

two-compartment fuel/smoke (liquid) tank is mounted behind the driver's cab. One feasibility model has been developed for testing at CSL and DPG; however, there is a requirement for live agent testing of decontamination equipment to determine actual effects of the decontamination system on items of equipment. The XM16 will be deployed in pairs providing a high velocity stream of hot exhaust gases to the contaminated vehicle surface. The projected IOC is January 1987. Figure 2-9 presents the feasibility model.

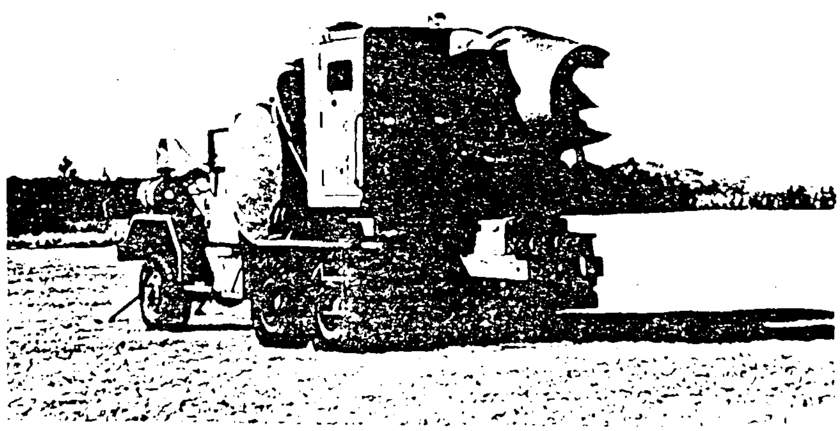


Figure 2-9. Jet-Exhaust Decontamination System

- The personal equipment decontamination system (PEDS) is being developed to provide clothing decontamination capabilities.

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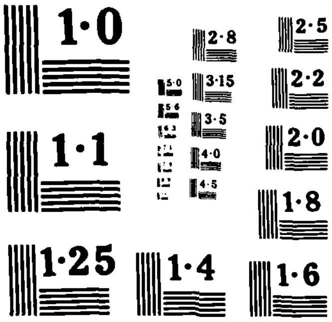

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The system will be mounted on the standard 1-½ ton trailer and will be used in conjunction with other personnel decontamination systems (that is, the lightweight decontamination system (LDS) and M12A1 PDDA). This system is in the early stages of development. The draft letter of agreement (LOA) states that the PEDS will decontaminate all clothing and equipment of 10 persons within 30 minutes. Cost data is not available at this stage of development.

- The XM15 interior surface decontamination system (ISDS) is being developed to allow vehicle crew members to decontaminate the inside of vehicles, vans, aircraft, and shelters. This system will utilize the hot-air principle and has an IOC of May 1987.
- The XM17, LDS/Norwegian NBC Sanator, is a portable (330 pounds), compact, gasoline driven pump and water heating unit which can draw water from any source and deliver it at controlled temperatures up to 120°C and pressures up to 100 pounds per square inch, gage (psig). The basic unit is supplemented by a 145 pound accessory kit containing hoses, cleaning jets, and personnel shower hardware. An auxiliary item is a rubberized fabric, self-supporting collapsible tank that holds 1,450 gallons of water. This decontamination device is currently being tested/ evaluated by both the Army and Marine Corps. In November 1981, FMFLANT conducted an independent field evaluation of the XM17. Preliminary results of this evaluation indicate that the XM17 performance was acceptable. A detailed report of the evaluation is being prepared by FMFLANT and is

not available for inclusion in this report. The cost per unit is $13,700 and the system can be purchased from a U.S. company. The XM17 is shown in figure 2-10, and the self-supporting tank in figure 2-11. The XM17's lightweight and small cubic area make it an ideal system for Marine combat units. It is easily man-portable for relatively moderate distances, does not take up much shipping space, and is capable of displacing contamination through the use of a hot water wash down.

The Marine Corps must actively follow the developments in decontamination to ensure that all requirements are met and that the most modern technology is applied to meet those requirements.

The following developmental decontamination systems which offer the most promise to fulfill USMC requirements should be considered for procurement. These items are recommended for the MAGTF decontamination system in paragraph 2.7.

- XM13, portable decontamination apparatus, is slated for first production delivery to the Army in February 1983. This item is recommended for replacement of the M11, and should be allocated one per each vehicle larger than ¼ ton, and each crew-served weapon larger than 60 caliber. Aviation squadrons should also have five for decontamination of a/c support equipment.
- XM14, vehicle-driven decontamination apparatus, has an IOC of December 1984. This vehicle is recommended for vehicle/heavy equipment intensive, aviation, and NBCD units as a replacement for the M12A1.

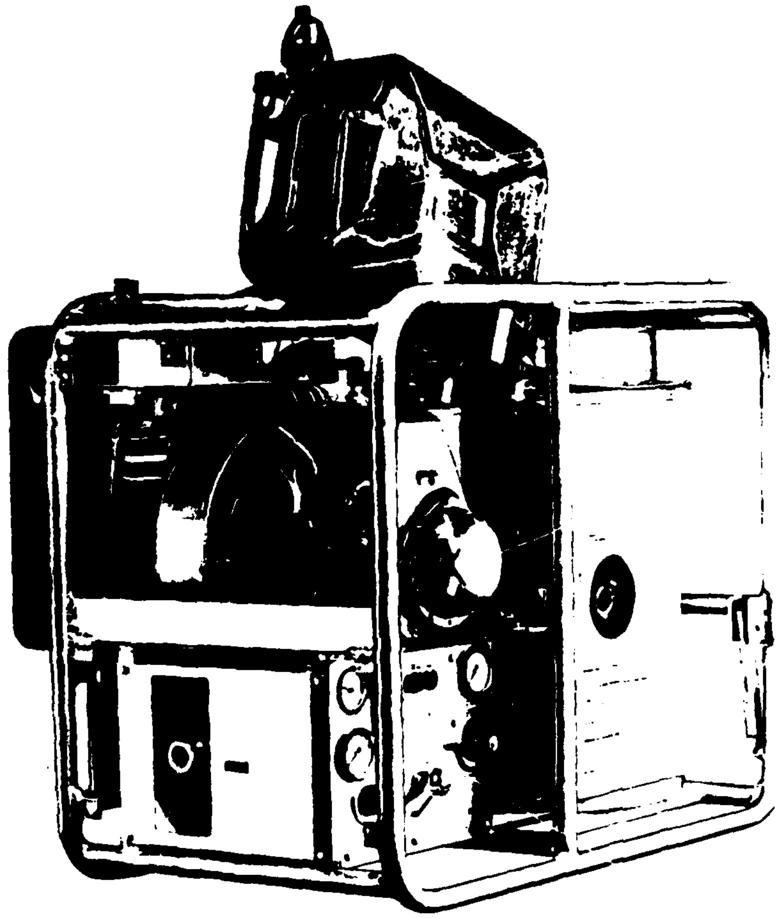

Figure 2-10. XM17 LDS

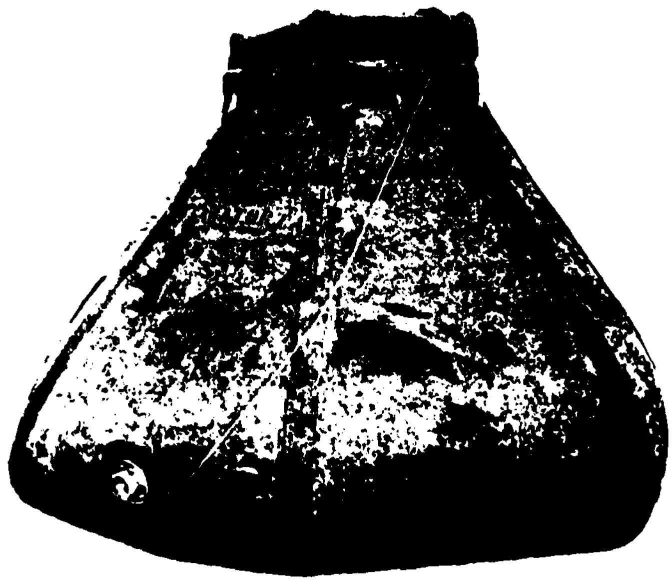

Figure 2-11. Self-Supporting Water Tank

- XM15, ISDS has an IOC of May 1987 and should be considered for units having vehicles, vans, shelters, aircraft, and other equipment that have interior surfaces sensitive to standard decontaminants.
- XM16, truck-mounted, jet-exhaust, has an IOC procurred in pairs for vehicle/heavy equipment intensive, aviation, and NBCD units.
- The PEDS and the N/MC shower facility development should be closely monitored to determine which system, or combination of systems, best satisfy Marine Corps requirements. The selected systems should be allocated to NBCD units and engineer organizations.
- XM17, LDS, is an off-the-shelf item which can be procured from a civilian contractor. This system, with the associated collapsible tank, should replace the M12A1 in every organization where XM14 and XM16 systems have not been recommended. Selected units have the requirement for additional XM17s.

2.6 RECOMMENDED DECONTAMINATION SYSTEM FOR THE MAGTF

2.6.1 Overall concept/doctrine.

The decontamination doctrine proposed in the Concept of Operations study[6] provides an improved capability for the MAGTF and remains valid with the exception that the requirement for battalion-sized combat units to perform complete decontamination should be revised.

Combat units operating in proximity to the enemy will not be able to provide personnel, or reduce their tactical operations enough to establish PDS or EDS. The same applies to combat support units engaged with the enemy. These units would probably be attacked with CB agents; combat

[6] See footnote 1, page 2-1.

units with NP agent, combat supports units with P and NP. Agents used in the attacks would depend, of course, upon the friendly unit situation and mission. Units attacked with NP agent need only to perform emergency, partial, and limited decontamination to survive and continue their mission. These units should have a capability to perform complete decontamination, but doctrine should stress that it is the exception rather than the rule for combat units to perform their own complete decontamination. Complete decontamination stations should be established towards the rear by higher headquarters NBC teams augmented by personnel from the contaminated unit being decontaminated.

Combat support units must have a mobile decontamination system capable of complete decontamination. Armor and artillery units would be targeted for P agents and may not always be able to move out of the contamination or may not be spared from support missions long enough to move to a rear area decontamination station. Therefore, they must have an organic, complete decontamination capability that can move with them.

Selected combat support/service support units that are equipment intensive must have sufficient assets to perform complete decontamination operations. Examples of such units are:

- Artillery battalions
- Tank battalions
- Assault amphibian battalions
- Engineer battalions
- Motor transport units
- Marine air base squadrons

Division, wing, and FSSG headquarters will be responsible for establishing PDSs and EDSs to provide the primary complete decontamination

capability for their organizations. These stations will be operated by the NBCD units augmented, as required, by combat support/service support, and the contaminated units.

Personnel decontamination stations (PDS) would not be required for combat units since, generally, they would be contaminated by NP agent. The U.S. Army has recently recognized this and removed the PDS from the battalions and located them at the brigade level. The data in the Dugway report supports such a reduction of decontamination capabilities at the battalion level.

Aircraft squadrons must have the capability of complete decontamination; however, helicopter, Harrier, and observation squadrons all of which operate from forward airfields would not need the large mobile decontamination apparatus. These squadrons should have the lightweight decontamination apparatus. Wing support squadrons and aircraft squadrons that operate from fixed installations must have sufficient assets of large, mobile equipment to perform complete decontamination. For these units, a combination of LDS, VMDA, and jet exhaust systems should be considered because of the differences in organization and mission.

Combat service support units must be capable of emergency, partial, limited and complete decontamination. Specific requirements for equipment to support complete decontamination are dependent on the individual unit's mission. For example, motor transport units should have VMDAs and jet exhaust systems, while supply units need the VMDA and LDA.

2.6.2 Individual decontamination system.

The individual Marine is responsible for emergency decontamination of exposed skin and the partial decontamination of his clothing, equipment, and personal weapon. To accomplish these two types of decontamination, the Marine must use the M13 and M258 decontamination kits.

The M13 kit includes a bag containing a powdered decontaminant which is to be used on the face and on clothing, equipment, and personal weapons to reduce the chemical hazard.

The M258 and M258A1 kits contain liquid solutions or wet towelettes for decontamination of exposed skin (except the face). This kit will decontaminate both nerve and blister agents.

Individual nuclear decontamination procedures require physical removal of radioactive material from the skin, clothing, equipment, position, and food as stated in paragraph 3 of the NBC Concept of Operations study. Biological agent decontamination includes delousing procedures, insect repellents, washing (person, clothing, equipment, and personal weapons), and accepted preventive medicine practices.

There is a requirement for larger, dry decontamination mitts to replace the bags currently in the M13 kit. The current bags do not provide enough powder to thoroughly decontaminate clothing, equipment, and personal/crew served weapons.

2.6.3 Combat/combat support decontamination system.

The combat/combat support decontamination system consists of the NBCD organization at the battalion level. Each battalion has one enlisted NBC specialist authorized on the T/O who provides for the training of decontamination teams, and for maintenance of the decontamination equipment. Combat battalions will train one six-man decontamination team to operate, as an additional duty, an LDS. It must be understood that activation of the decontamination team at this level is not a normal occurrence, but it is the exception since doctrine prescribes that complete decontamination operations occur in relatively clean areas located to the rear of the MBA.

Battalion NBC decontamination teams will remain "trained" as an additional duty. However, the requirement for these decontamination teams to wear the rubberized protective clothing should be discontinued and the following TAM items should be deleted from the table of equipment.

- C2030--boots, protective, M2A1.
- C2038--cover, cooling, gas mask hood.
- C2040--cover, footwear.
- C2050--coveralls, M3.
- C2160--gloves, M4.
- C2230--maintenance kit, protective clothing.
- C2310--suit, cooling.

Equipment required for combat/combat support battalions include:

- XM13, portable decontamination apparatus for each crew-served weapon larger than 60 caliber, and each assigned-vehicle.
- XM17, LDS.
- XM14, VMDA, for units that are vehicle-/equipment-intensive.
- XM16, jet-exhaust system, for vehicle-intensive units.
- XM15, ISDS for self-propelled artillery, tank, and assault amphibian units.

These units should have the XM13, XM14, and, in some cases, the XM16 decontamination systems as T/E items.

The division and wing NBCD teams have trained specialists and specialized equipment (such as the M12A1 and its proposed replacements, the XM14, VMDA, LDS, and the XM16, jet-exhaust system) to perform complete decontamination operations for contaminated, subordinate, combat and combat support

units. The division and wing engineer units will provide personnel and earth moving equipment to assist contaminated and NBCD units in large area decontamination.

Equipment decontamination stations (EDSs) will be established by NBCD units at the division, wing, FSSG, and other designated combat support and combat service support units.

2.6.4 Combat service support (CSS) decontamination.

The CSS decontamination system consists of personnel (in operational and NBCD units), and equipment. Each battalion T/O has a trained NBC specialist. Since CSS units are equipment/material intensive and cannot easily move out of contamination, each battalion must be capable of complete decontamination, and have a six-person decontamination team trained as an additional duty.

CSS battalions are currently authorized M11 and M12A1 decontamination apparatus, and should have a combination of replacement items (XM13, XM14, XM15, XM16, XM17, and the Navy/Marine Corps shower/laundry facility (N/MCS)) based on their mission and concept of operations.

The FSSG headquarters are authorized the NBC specialists to operate three decontamination teams. These teams are equipped with the M11 and M12A1 decontamination apparatus which should be replaced by the XM13, XM14, XM16, and XM17. The teams also require the XM15, N/MCS, sacrifical coating (SC), thin film flakes (TFF), corona discharge (CD), and laser (L) items when they are fielded.

2.6.5 Aviation unit decontamination system.

Marine Corps aviation presents a unique decontamination problem because advance expeditionary airfields (EAFs) will become primary targets for P and M agents. Since few suitable airfields will be located within

the AOA, aviation units will be unable to move, once contaminated, and will require complete decontamination capability. Each squadron must have this capability.

Aircraft and control squadrons will have one NBC specialist assigned by T/O. These units will also train a six-person decontamination team capable of operating the LDS allocated to each squadron.

Marine air base squadrons (MABS) and headquarters and maintenance squadrons (H&MS) will also have an NBC specialist assigned and will train two six-person decontamination teams for operating the LDS and VMDA. These teams will also be able to use the SC, TFF, and corona discharge techniques of decontamination when they are fielded.

The wing engineer (WES) and Marine wing service group headquarters squadrons, will also each have a trained NBC specialist and two decontamination teams which will operate, as additional duty, the XM14, and XM16. The WES must also provide, upon request, personnel and earth moving heavy equipment for large area decontamination.

A major consideration for aviation should be contamination avoidance actions, such as covering the cockpit area and the intake ducts. If possible, overhead cover should be provided for each aircraft to prevent agent contamination. The concept of SC may provide an inexpensive method to cover the majority of the aircraft with a coating that is easily removed when contaminated.

The concept of TFF immobilization appears to have merit as a means of covering contaminated runways and taxi areas. If this method proves out, it would greatly reduce the decontamination needed to make undercarriages, wheel wells, tires, ammunition access hatches, weapons stations, and so forth, clean for continued operations in a toxic environment.

The recommendations proposed for the MAGTF decontamination system provide the basis for a Marine Corps-wide system. This system is summarized in table 2-8.

2.7 DECONTAMINATION SYSTEM REQUIREMENTS

2.7.1 Decontamination equipment requirements.

The equipment required to implement and support the decontamination system which has been recommended in paragraph 2.6 is presented in tabular form in table 2-9. This includes current standard items as well as developmental items which should be available in the near future. In addition some conceptual items are listed for longer term procurement actions.

2.7.2 Decontamination system personnel requirements.

The proposed decontamination system will require additional personnel in the maintenance, motor transport, (35) and jet-exhaust decontamination operator, NBC (57), OccFlds.

There are no changes to the NBC personnel billets proposed in the NBC Concept of Operations study. The requirements for primary and additional duty billets will not change as a result of this study analysis; however, the study team believes that after extensive field evaluations there may be a requirement for adjustment of the number of billets in the NBC units.

The new personnel requirements include maintenance personnel for both the XM14, and the XM16 decontamination systems. Additionally, the XM16 will require a dedicated, formally-trained operator. The estimated cost per new billet is $13,000 per year. The proposed number of new personnel is shown in table 2-10.

Table 2-8. The MAGTF Decontamination System

	INDIVIDUAL	CO/BTRY	BN/SQDN	MAU	REGT/GRP	MAB	DIVISION	WING	FSSG	MAF
LEVEL OF DECON	Emergency	Limited/ Partial	Limited/ Partial/ Complete*	Limited/ Partial/ Complete*	Limited/ Partial/ Complete*	Complete	Complete	Complete	Complete	Complete
TYPE OF DECON	Individual, Personal Weapons, Clothing and Equipment	Unit mission Essential Equipment	Unit mission Essential Equipment	Unit mission Essential Equipment	Unit mission Essential Equipment	Complete	Complete	Complete	Complete	Complete
CURRENT EQUIPMENT	M13 M258	M13 M11	M13 M11 M12A1	M13 M11 M12A1	M13 M11 M12A1	M13 M11 M12A1	M12A1	M12A1	M12A1	M12A1
CURRENT REQUIREMENTS	1 per individual	M13-1 per individual M11-1 per wpn/vehicle	M13-1 per individual M11-1 per wpn/vehicle	M13-1 per individual M11-1 per wpn/vehicle	M13-1 per individual M11-1 per wpn/vehicle	M12A1- 1 per bn	M12A1- 1 per bn	M12A1- 1 per sqdn	M12A1- 1 per bn	M12A1- 1 per bn
CURRENT PERSONNEL	Individual responsibility	Crew responsibility	Crew responsibility. Additional duty	Additional duty	Additional duty	Additional duty	NBCD unit assigned	NBCD unit assigned	NBCD unit assigned	NBCD unit assigned from subordinate commands
CURRENT PROCEDURES	Scrape/ blot/dust	Dust/wash/ scrub/rinse	Dust/wash/ scrub/rinse	Dust/wash/ scrub/rinse	Dust/wash/ scrub/rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse	Scrub/ spray/ rinse
CURRENT DEFICIENCIES/ DEVELOPMENT REQUIREMENTS	Larger dusting mitts and towelletes, improved and decon solutions	Larger dusting mitts, portable decon system (capacity)	Dusting mitts, towelletes, portable decon, lightweight decon, universal decon agent, coating	Dusting mitts, towelletes, portable decon, lightweight decon, universal decon agent, coating	Dusting mitts towelletes, portable decon, lightweight decon, universal decon agent, mobile decon system	Mobile decon system, large area/ rapid decon system, universal decon agent, interior decon, coating	Mobile decon system, large area/ rapid decon system, interior decon, universal decon agent, coating, agent immobilization, clothing/ equipment decon	Same as Division	Same as Division	Same as Division
DEVELOPMENT EQUIPMENT	M258A1	XM13-portable decon, apparatus, 14 liter XM17, lightweight decon system	XM13, XM17, XM15 - interior surface decon, XM14 - vehicle mounted decon system, XM16-jet exhaust decon system	XM13, XM17, XM15, XM14, XM16	XM13, XM17, XM15, XM14, XM16	XM13, XM17, XM15, XM14, XM16, Personnel equipment decon system (PEDS shower/ laundry unit	XM13, XM17, XM15, XM14, XM16, PEDS, shower/ laundry	Same as Division	Same as Division	Same as Division
CONCEPTUAL EQUIPMENT						Thin-film flakes, sacrificial coating, corona discharge laser	Same as MAB	Same as MAB	Same as MAB	Same as MAB
RESEARCH AND DEVELOPMENT REQUIREMENTS	Improved dry decon capability, improved decon solutions	Improved dry decon capability, improved decon solutions	Improved dry decon capability, improved decon solutions	Decon monitor, dry decon, solutions, universal decon agent	Decon monitor, dry decon, solutions, universal decon	Decon monitor dry decon, solutions, universal decon agt	Same as MAB	Same as MAB	Same as MAB	Same as MAB
PERSONNEL REQUIREMENTS	No Additional	Personnel	Maintenance & Operator	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as Bn/Sqdn	Same as [illegible]

*Not routine operations but equipment available, if required.

Table 2-9. Proposed Decontamination Equipment Allocation

	Decontamination Equipment													
	Current				Developmental						Conceptual			
ORGANIZATION	M13 (1)	M258 (1)	M11 (2)	M12A1	XM13 (3)	XM14 (4)	XM15 (5)	XM16 (4)	XM17 (4)	N/MCS	SC (5)	TFF (5)	CD (5)	L (5)
FMF														
H&S Bn, FMF														
CAG														
Force Recon Co.														
ANGLICO														
Radio Bn			X	1	X		X		1					
Comm Bn, Hq Co.			X	1	X		X		1					
Comm Co.			X		X									
LL Co.			X		X									
Comm Sup Co.			X		X									
Division														
Infantry Regt, Hq, Co.			X		X									
Infantry Bn, H&S Co.			X	1	X				1				X	
Infantry Wpns Co.														
Rifle Co.														
Artillery Regt Hq Btry			X		X						X			
Artillery Bn, Hq Btry			X	1	X	2	X		2		X		X	
Artillery Btry, 105			X		X						X			
Artillery Btry, 155T			X		X						X			
Artillery Btry, 155SP			X		X		X				X			
Artillery Btry, 175			X		X						X			
Artillery Btry 8 in			X		X						X			
Recon Bn. H&S Co.			X	1	X									
Recon Co.														
Tank Bn, H&S Co.			X	1	X	1	X	2	1		X		X	
AT Co.			X		X		X				X			
Tank Co.			X		X		X				X			
ASLT Amphib Bn, H&S Co.			X	1	X	1	X	2	1		X		X	
ASLT Amphib Co.			X		X		X				X			
CBT Engr Bn H&S Co.			X	1	X				1	1	X	X	X	
Engr Spt Co.			X		X						X			
CBT Engr Co.			X		X						X			
Hq Bn, Div, Hq Co.			X	1	X	6	X	2	2	1	X	X	X	X
SVC Co.			X		X									
Truck Co.			X		X	1								
MP Co.			X		X									
Comm Co.			X		X									

Note:
(1) 1 per individual
(2) 1 per crew served weapon/vehicle, 5 per squadron
(3) Replacement for M11
(4) Replacements for M12A1
(5) System not defined so quantity cannot be recommended

Table 2-9. Propoed Decontamination Equipment Allocation (Continued)

	Decontamination Equipment													
	Current				Developmental						Conceptual			
ORGANIZATION	M13 (1)	M258 (1)	M11 (2)	M12A1	XM13 (3)	XM14 (4)	XM15 (5)	XM16 (4)	XM17 (4)	N/MCS	SC (5)	TFF (5)	CD (5)	L (5)
Wing														
MWHS			X	1	X	5	X	4	2	1	X	X	X	X
MACG														
H&HS			X		X				1				X	
MWCS			X	1	X		X		1					
MACS			X	1	X		X		1					
MASS			X	1	X		X		1					
MATCS			X	1	X		X		1					
FAAD Btry														
LAAM Bn, H&S Co.			X	1	X	1	X		1		X			
LAAM Btry			X		X		X							
VMGR			X	1	X				1		X			
VMAQ			X	1	X				1		X			
VMFP			X	1	X				1		X			
MAG VF/VA														
H&MS			X	1	X	1			1					
MABS			X	1	X	1	X	2	1		X	X	X	
VMA/AV8			X	1	X				1		X			
VMA/A4			X	1	X				1		X			
VMFA/F4			X	1	X				1		X			
MAG VA														
H&MS			X	1	X	1			1		X			
MABS			X	1	X	1	X	2	1		X	X	X	
VMO			X	1	X				1		X			
HML			X	1	X				1		X			
HMA			X	1	X				1		X			
HMM			X	1	X				1		X			
HMH			X	1	X				1		X			
MWSG														
HQ Sqdn			X	1	X	2		2	1	1	X			
WES			X	1	X	2		2			X	X	X	
WTS			X	1	X				1		X			

Note:
(1) 1 per individual
(2) 1 per crew served weapon/vehicle, 5 per squadron
(3) Replacement for M11
(4) Replacements for M12A1
(5) System not defined so quantity cannot be recommended

Table 2-9. Proposed Decontamination Equipment Allocation (Continued)

ORGANIZATION	Current: M13 (1)	Current: M258 (1)	Current: M11 (2)	Current: M12A1	Developmental: XM13 (3)	Developmental: XM14 (4)	Developmental: XM15 (5)	Developmental: XM16 (4)	Developmental: XM17 (4)	Developmental: N/MCS	Conceptual: SC (5)	Conceptual: TFF (5)	Conceptual: CD (5)	Conceptual: L (5)
FSSG														
H&S Bn, H&S Co.			X	1	X	3		4	2	1	X	X	X	X
Comm Co			X		X									
MP Co			X		X									
Svc Co			X		X									
Ldg Spt Bn, H&S Co.			X	1	X	1			1		X	X		
B&P Opns Co.			X		X									
Ldg Spt Co.			X		X	1					X			
Sup Bn, H&S Co.			X	1	X	1		2	2		X	X	X	
Med Log Co			X		X									
Sup Co.			X		X									
Ration Co			X		X									
Ammo Co			X		X									
Maint Bn, H&S Co.			X		X		X				X			
Ord Maint Co.			X		X		X				X			
MI Co.			X	1	X	1	X				X			
Engr Maint Co.			X		X						X			
Elect Maint Co.							X				X		X	
G/S Maint Co.			X	1	X		X				X			
Engr Spt Bn, H&S Co			X	1	X	2		2	2	1	X	X		
Support Co			X		X						X	X		
Bridge Co.			X		X		X					X	X	
Bulk Fuel Co.			X		X									
MT Bn, H&S Co.			X	1	X	4	X	2	2		X		X	
Truck Co.			X		X						X			
Transport Co			X		X						X			
Marg Ter Veh Co.			X		X						X			
Med Bn, H&S Co.			X	1	X	4	X		1		X			
Hosp Co.			X		X									
Dental Bn, H&S Co.			X	1	X	1	X		1		X			
Dental Co.			X		X									

Note:
(1) 1 per individual
(2) 1 per crew served weapon/vehicle, 5 per squadron
(3) Replacement for M11
(4) Replacements for M12A1
(5) System not defined so quantity cannot be recommended

Table 2-10. Additional Personnel Required by the Porposed MAGTF Decontamination System

Organization	Unit Requirements Maintenance XM14	Unit Requirements Maintenance XM16	Unit Requirements Operator XM16	Total Active Requirements Maintenance XM14	Total Active Requirements Maintenance XM16	Total Active Requirements Operator XM16
Division						
Hq Bn	6	1	2	18	3	6
Arty Bn	2	1	2	18	9	18
Tank Bn	1	1	2	3	3	6
Aslt Amphib Bn	1	1	2	3	3	6
	10	4	8	42	18	36
Wing						
MWHS	5	2	4	15	6	12
LAAM Bn	1	0	0	3	0	0
H&MS (MAG)	1	0	0	13	0	0
MABS	1	1	2	13	13	26
Hq Sqdn (MWSS)	1	1	2	3	3	6
WES	1	1	2	3	3	6
	10	5	10	50	25	50
FSSG						
H&S	1	2	4	3	6	12
Ldg Spt Bn	1	1	1	3	3	3
Sup Bn	1	1	2	3	3	6
MT Maint Co.	1	1	0	3	3	0
Engr Spt Bn	1	1	2	3	3	6
MT Bn	2	1	2	6	3	6
Med Bn	1	0	0	3	0	0
Dent Bn	1	0	0	3	0	0
	9	7	11	27	21	33
Total	29	16	29	119	64	119

2.7.3 Decontamination system team training requirements.

Decontamination teams should be school-trained at either the U.S. Army Chemical School or command-sponsored NBC schools. The command-sponsored NBC schools should train personnel who are assigned to decontamination teams as an additional duty. All members of the division, wing, and FSSG NBC units should be trained at the U.S. Army Chemical School.

The additional billets proposed in paragraph 2.7.2 require school training. Operators of the XM16 also should be trained at the U.S. Army Chemical School. It is estimated that this training would last 6 weeks. The estimated cost per individual, in FY82 dollars would be $8.30 per diem a day (quarters and messing available), $400 transportation from Camp Lejeune, and $800 transportation from San Diego/Camp Pendelton.

XM-16 maintenance personnel should be trained at the Motor Transport School at Camp Johnson, North Carolina. The cost of per diem would also be $8.30 a day, and the transportation from Camp Pendelton to Camp Johnson would be approximately $800. The existing motor transport maintenance course a (10-week course) should be used for this requirement.

The NBC specialist assigned as the operator of either the XM14 or XM16 should be responsible for maintenance of the NBC components of those systems.

Commanders should ensure that decontamination teams are exercised and that NBC play is integrated into a unit's field training. This training should be conducted to acquaint all personnel with emergency, partial, and limited decontamination procedures, as well as prepare the teams for complete decontamination operations.

2.8 SUMMARY

The requirements for a Marine Corps decontamination system have been proposed in this chapter. This system includes current, developmental, and

conceptual items of equipment, (shown in table 2-9), additional personnel, (table 2-10), and increased training requirements.

The doctrine proposed in the NBC Concepts of Operation study remains valid, except that combat units normally will not perform complete decontamination. However, they will have the equipment and personnel trained as an additional duty, to perform such decontamination in exceptional situations.

The reduction in contamination persistency, as stated in the Dugway Proving Ground report, influenced the study team in the selection of the proposed decontamination system. The proposed recommendations, as shown in table 2-11, provide elements of the MAGTF with the decontamination capability to survive and continue their assigned mission on the integrated battlefield.

However, there will be times in a combat situation when individuals and units will be forced to remain in an NBC-contaminated environment for prolonged periods. In those cases when the proposed decontamination system is neither possible nor practicable, a method of CP is required. Chapter 3, this volume, discusses the CP that provides a protective environment in which (1) individuals can carry out tactical functions efficiently without the encumbrance of individual chemical and biological protective equipment; (2) individuals can find relief from wearing individual protective equipment and can eat, sleep, and perform personal hygiene; and (3) which can be used as a clean area for key personnel in case of a chemical attack.

Table 2-11. Recommended Decontamination System Program

Recommendation	Additional Personnel	Equipment[1]	Procedures	Training	Cost
1. Delete M12A1 and associated protective clothing from infantry, recon, and combat engineer battalions.	No change (N/C). Requirement for trained decontamination team remains.	Transfer M12A1 to division NBC team, tank, aslt, amphibious, and artillery battalions.	N/C	N/C	None
2. Replace M12A1 with XM14 VMDA.	One maintenance man/operator, one per vehicle.	VMDA/XM14	Rinse procedures will change with self-contained	Maintenance course--10 weeks, NBC-minimal, a 1 week refresher course at Command NBC school.	Equipment--not available. Training--$8.30 per diem a day for Personnel--10 weeks, $13,000 per individual a year.
3. Replace M12A1 with XM16 jet-exhaust.	One maintenance operator, one truck maintenance per vehicle.	XM16, jet-exhaust	Initiate new procedures.	Six week operator course.	Equipment-not available. Training-$8.30 per diem per day for six weeks. Personnel-$13,000 per individual per year.

Note:

[1]Specific equipment recommendations were previously shown in table 2-9.

Table 2-11. Recommended Decontamination System Program (Continued)

Recommendation	Additional Personnel	Equipment[1]	Procedures	Training	Cost
4. Replace M11 with XM13 PDA.	N/C. Operator maintained.	XM13	Initiate new procedures.	OJT by Bn NBC NCO.	Equipment-$130.00 each.
5. Replace M12A1 with XM17 LDS.	N/C additional duty personnel.	XM17	Minor change.	One week course at Command NBC school.	Equipment-$13,700 each.

Note:

[1]Specific equipment recommendations were previously shown in table 2-9.

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 3

COLLECTIVE PROTECTION SYSTEM REQUIREMENTS

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR

DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 3. COLLECTIVE PROTECTION SYSTEM REQUIREMENTS

3.1 INTRODUCTION

3.1.1 Background.

Chemical weapons can be employed by an enemy in support of all levels of command, and in concert with nuclear and/or conventional fire support measures. This broad employment of chemical weapons would place the maximum chemical warfare (CW) burden on Marines by causing significant casualties and neutralizing selected targets, inhibiting or denying unrestricted use of key terrain, and by delaying and disrupting the commitment of reserves. Combat effectiveness is further degraded by the use of chemical weapons by forcing Marines to operate for prolonged periods in debilitating protective equipment. Soviet/Warsaw Pact (WP) tactics stress the offense by featuring mass, momentum, and continuous land battle tactics. Chemical agent use is designed to reduce personnel strength and speed of movement, and to alter the direction of the attack. This would be done by employing chemical munitions (to include air-delivered CW agents) against personnel and materiel during the critical assault phase of amphibious operations to cause maximum disruption and chaos. The chemical munitions could also be employed against the key avenues of approach of lead assault battalions in the FBH to reduce their momentum.

The NBC Defense Readiness study, previously cited in chapter 2 (page 2-1), describes in great detail the threats nuclear, biological, and chemical (NBC) weapons and their doctrinal employment as just summarized. The study further identified requirements for some form of collective protection (CP) for the Marine air ground task force (MAGTF). There is no question that essential

functional facilities such as those housing command and control operations, communications, extensive medical treatment, and so forth, must use some form of CP. However, it is vitally important that considerable thought be given to, and great care taken in, the selection of facilities to be used as rest, survival, and combat related functional shelters.

The Marine commander's problem is to develop a policy that will provide a judicious balancing of the divergent requirements involved; namely, the importance of protecting personnel and materiel against contamination, and of pursuing the mission. Commanders at all levels are responsible for making this policy decision; therefore, they must be prepared to cope with the burdens imposed by an NBC environment.

Combat forces operating astride the main enemy avenues of approach will be likely targets for nonpersistent (NP) chemical agents. Combat forces on the flanks of attacking enemy forces will be targeted for persistent (P) chemical strikes (see figure 2-1, page 2-3, for a schematic of the integrated battlefield). Artillery units and other forces in the regimental and division rear areas will be prime targets for nuclear and for both P and NP chemical attacks. Logistic support areas (LSAs) and aviation installations may be hit with a combination of all NBC weapons--the battlefield will be lethal and contaminated ("dirty"). NBC protective equipment and measures will be essential in order to continue mission operation.

The basic principle for mission accomplishment on the integrated battlefield will be one of survive to operate (STO) as specified in Concepts of Operation for NBC Defense (NBCD) in the Midrange (cited on page 2-2). Combat forces can achieve STO by wearing specific levels of protective material as detailed by the mission-oriented protective posture (MOPP). This posture

provides the individual Marine with the necessary means of continuing the mission in an NBC environment. However, this implies that encapsulation for all Marines will be of paramount importance because of the potentially disastrous results of chemical agent attack and undesirable effects from the nerve-agent antidote that must be taken after exposure. Presently, prevention of exposure is what all Marines must practice until a better prophylaxis for nerve-agent poisoning is available. This means that aircrews and pilots have to accomplish their mission in a contaminated environment while wearing protective ensembles; it also means that ground forces must fight in protective ensembles in a like environment. This must be a matter of policy and not choice if the MAGTF is to survive and continue operations within the force beachhead (FBH) or during subsequent operations ashore.

3.1.2 Mission-oriented protective posture.

Marines fighting on the integrated battlefield must be told what level of protection (MOPP) they should assume when exposed to an NBC environment. The MOPP level will rely on intelligence sources which predict the probability of enemy NBC weapon emeployment. This transition can be readily shown as the risk level (probability of enemy employment) rises; the MOPP level must then rise accordingly, as shown in figure 3-1. Of course, the converse to the situation applies as well.

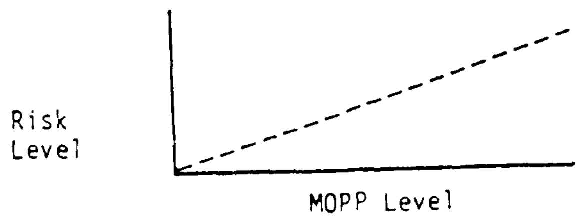

Figure 3-1. MOPP Level versus Risk Level

These MOPP levels are in two categories, unit nuclear protection and chemical/biological (CB) protection. The latter, an individual means of protection, produces heat stress problems over time. However, as the situation and mission permit, these problems can be compensated for by using some form of CP. Both of these categories are described in the following subparagraphs.

3.1.2.1 Unit nuclear-defensive posture (NDP). Units will assume a nuclear-defensive posture (NDP) when the threat indicates that nuclear warfare will be initiated. The three categories of NDP are shown in table 3-1.

Table 3-1. Categories of Nuclear Defensive Posture

NDP Level	Action
1	Disperse units or stay close to enemy. Turn off and disconnect antennae on radios and other electronic equipment in redundant roles. Continue normal mission.
2	Maintain dispersion or continue to stay adjacent to enemy (SATE). Prepare personnel and equipment shelters. Prepare to occupy shelters on short notice. Turn off and disconnect antennae on radios and other electonic equipment on all nonmission essential nets. Put canvas top back on vehicles.
3	Put equipment, vehicles, and supplies in defilade positions or shelters. Occupy bunkers, fighting holes, or tanks in defilade positions. Close aircraft canopies/doors and cover engine inlet/exhaust ducts. Button up tanks/landing vehicle track (LVT). Turn off and disconnect antennae on all but essential radios and other electronic equipment.

During a nuclear attack, unit protection consists of taking cover, assuming MOPP3, and suspending activities until initial nuclear effects are over. After the initial effects are over, commands must immediately determine both the existence of fallout and the contamination pattern which will be formed. They must make predictions to accomplish the following:

- Warn or alert subordinate units and personnel to expect radiological contamination.
- Aid in tactical planning.
- Form a basis for radiological survey planning.

3.1.2.2 Chemical protection.

Chemical protection for units consists of the commander's establishment of MOPP levels, establishment of contamination avoidance criteria, and utilization of collective protection equipment (CPE). This protection is also viable against biological warfare (BW) if the BW agents are detected early enough.

The wearing of chemical protective clothing and the carrying of NBCD equipment will be directed by the senior operational headquarters and will be based on the threat analysis or upon initiation of CW. Once the wearing of protective clothing has been directed, it will become the standard field uniform for troops in the command. Tables 3-2 and 3-3 depict MOPP levels as described in the Concept of Operations for NBC Defense (NBCD) in the Midrange.

Division and wing commanders will direct minimum MOPP levels of their subordinate units. Subordinate commanders at the battalion/squadron level may, before the start of a mission, direct that this level of protection be increased, decreased, or varied among individiuals or elements within the unit according to their evaluation of the current situation and operational limitation. The subordinate commanders must realize that as the temperature

Table 3-2. MOPP Levels Before Chemical Attack

MOPP	Overgarment	Overboots	Mask with Hood	Gloves
1	Worn open or closed, based on temperature	Carried	Carried	Carried
2	Same as MOPP1	Worn	Carried	Carried
3	Same as MOPP1	Worn	Worn, hood open or closed based on temperature	Carried
4	Worn closed	Worn	Worn, hood closed	Worn
CR[1]	Open or off based on mission and proximity to enemy	Off	Mask worn, hood off	Off

[1]CR--Commander's Risk. The commander, based upon proximity of enemy forces, situation, and indication of possible use of NP agents, will determine, by consulting with the unit NBCD specialist, when to utilize this decreased level of protection.

Table 3-3. MOPP Levels After Chemical Attack

Current MOPP	Item already worn	What needs to be put on (in order)
1	Overgarment	1. Mask with hood 2. Gloves 3. Zip overgarment hood 4. Overboots
2	Overgrment and overboots	1. Mask with hood 2. Gloves 3. Zip overgarment and hood
3	Overgarment, overboots, and mask with hood	1. Gloves 2. Zip overgarment and hood

and work rate increase, the level of individual protection must be reduced, and work pace options must be taken; they must also accept the possibility of greater numbers of heat casualties. The effects over time of remaining in an environment contaminated with P, also referred to as long term degradation due to encapsulation (MOPP4), are shown in table 3-4. Commanders will have to determine how long Marines can remain encapsulated. Table 3-4 provides a guide for commanders to plan on longer times to accomplish specific functions while in MOPP4 versus doing the same task without protective clothing. The amount of degradation in unit effectiveness from heat stress caused by wearing CW protective clothing is a function of several variables. Among these are (1) the type and combinations of environmental and protective ensemble worn, (2) the environmental conditions prevailing at any given time, (3) the duration during which a specific ensemble is worn, (4) the level of labor or activity sustained during the time a specific ensemble is worn, (5) the physical state of the personnel at the time the CW ensemble is donned, and (6) the degree to which the unit is trained in wearing protective clothing.[1]

A passive means of protection is contamination avoidance. Contamination is avoided by covering personnel, equipment, and supplies prior to being attacked by NBC weapons; or, subsequent to an attack, bypassing, whenever possible, contaminated areas. Contamination avoidance by covering is a critical requirement for aviation units. They must ensure that aircraft (cockpit and engine/exhaust duct areas especially), electronic equipment, and maintenance areas are free of contamination by liquid agents.

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[1] Technical Report No. 313, The Effect of Chemical Protective Clothing and Equipment on Combat Efficiency, Army Materiel Systems Analysis Activity (AMSAA), Aberdeen Proving Ground, Maryland, November 1981, UNCLASSIFIED.

TABLE 3-4. PERFORMANCE DEGRADATION DATA FOR SPECIFIED UNITS IN A CW ENVIRONMENT[2]

				Times Required to Accomplish Functions			
				W/O Protective Clothing*	While in MOPP 4 (Full Protective Ensemble)		
	Major Function	Description	Workload		@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
TYPE OF TANK UNIT							
COMPANY, 3 Platoons, 15 Tanks	Position Selection	By commander, per move	Moderate	1 hr	1 hr	1 hr	3 hrs
	Command post move	Per move	Moderate	15 min	15 min	15 min	45 min
Platoon, 5 Tanks	Displacement, 5km distance	Across terrain where no trail exists @ 2-3 km/hr	Light	2 hrs	2 hrs	2 hrs	3.5 hrs
		Advancing with infantry @ 2-3 km/hr	Light	2 hrs	2 hrs	2 hrs	3.5 hrs
Platoon	Maintenance	Replace tank engine (4 men, pull and reinstall)	Heavy				
		For XM1		2 hrs	4 hrs	6 hrs	12 hrs
		For M60		4 hrs	8 hrs	12 hrs	24 hrs
		Replace track (done in place by crew)	Heavy				
		For thrown track		1 hr	2 hrs	3 hrs	6 hrs
		For damaged track		2 hrs	4 hrs	6 hrs	12 hrs
TYPE OF ARTILLERY UNIT							
155 (SP) Battery	Fire Mission[1]	6 Howitzers/5 volleys (1 in Effect)	Heavy	8.5 min	17 min	25.5 min	51 min
	Site Occupation	Emergency[2]	Heavy	15 min	30 min	45 min	90 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

[2]Extracted from reference in footnote 1, page 3-7.

TABLE 3-4. PERFORMANCE DEGRADATION DATA FOR SPECIFIED UNITS IN A CW ENVIRONMENT[2] (Cont'd)

				Times Required to Accomplish Functions			
				W/O Protective Clothing*	While in MOPP 4 (Full Protection Ensemble)		
	Major Function	Description	Workload		@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
		Deliberate[3]	Heavy	20 min	40 min	60 min	120 min
	Site Displacement	Emergency[4]	Heavy	3 min	6 min	9 min	18 min
		Deliberate[5]	Heavy	30 min	60 min	90 min	180 min
	Road March	30 km/hr	Light	(Max) 12 hrs day	12 hrs day	12 hrs day	12 hrs day
	Reconnaissance and Position Selection	Deliberate	Moderate	1 hr	1 hr	1 hr	1.5 hr
	Ammo Supply	Turn around time for 10 km trip - 5 ton truck/155 mm ammo	Moderate - Heavy	4 hrs	4-6 hrs	4-8 hrs	6-12 hrs
TYPE OF AVIATION UNIT							
Combat Aviation Battalion[6]	Maintenance, Scheduled	Daily (if aircraft flew day before)	Moderate	1 hr/aircraft (ac)	1 hr/ac	1 hr/ac	3 hrs/ac
		Every 25 hrs of flying time[7]	Moderate	3 hrs/ac	3 hrs/ac	3 hrs/ac	9 hrs/ac
		Every 100 hrs of flying time[7]	Moderate	72 hrs (avg)/ac[8]	72 hrs/ac	72 hrs/ac	216 hrs/ac
		For UH-60, daily	Moderate	2 hrs/ac	2 hrs/ac	2 hrs/ac	6 hrs/ac
		For UH-60, after 50 hrs flying time	Moderate	6 hrs/ac	6 hrs/ac	6 hrs/ac	18 hrs/ac
		For UH-60, after 300 hrs flying time	Moderate	144 hrs/ac	144 hrs/ac	144 hrs/ac	432 hrs/ac

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 3-4. PERFORMANCE DEGRADATION DATA FOR SPECIFIED UNITS IN A CW ENVIRONMENT[2] (Cont'd)

				Times Required to Accomplish Functions			
				W/O Protective Clothing*	While in MOPP 4 (Full Protective Ensemble)		
	Major Function	Description	Workload		@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
TYPE OF ENGINEER UNIT							
Line Company	Dig tank ditch, 2 digging vehicles in any combination	3.2m Wide x 1.8m deep	Moderate	2.5 hrs/100m length	2.5 hrs/100m length	2.5 hrs/100m length	7.0 hrs/100m length
	Minefield emplacement: w/M57 towed mine dispenser	300m long x 50m deep[9]	Moderate	1 platoon hr	1 platoon hr	1 platoon hr	3 platoon hrs
	By hand	100m long x 100m deep[9]	Heavy	4 squad hrs	8 squad hrs	12 squad hrs	24 squad hrs
	Disable bridges	4 lane highway	Heavy	3 squad hrs	6 squad hrs	9 squad hrs	18 squad hrs
		2 lane primary road	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	12 squad hrs
	Build road crater, average size (terrain dependent)	50m long x 25m wide x 4m deep	Heavy	2 squad hrs	4 squad hrs	6 squad hrs	12 squad hrs
	Bridging	Temporary fording[10]	Heavy	1 hr for equipment	2 hrs for equipment	3 hrs for equipment	6 hrs for equipment
		Mobile assault bridge:					
		Ideal conditions	Heavy	200m/hr	200m/2 hrs	200m/3 hrs	200m/6 hrs
		w/fast current	Heavy	150m/hr	150m/2 hrs	150m/3 hrs	150m/6 hrs
TYPE OF INFANTRY UNIT							
Squad, 9 man	Position preparation, 2-man	Hasty, minimum protection					
		In sand	Heavy	10 min	20 min	30 min	60 min

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 3-4. PERFORMANCE DEGRADATION DATA FOR SPECIFIED UNITS IN A CW ENVIRONMENT[2] (Cont'd)

				Times Required to Accomplish Functions			
				W/O Protective Clothing*	While in MOPP 4 (Full Protective Ensemble)		
	Major Function	Description	Workload		@20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
		In clay	Heavy	120 min	240 min	360 min	720 min
		In plowed, loose dirt	Heavy	30 min	60 min	90 min	180 min
	Road march (normal)	4 km @ 4 km/hr	Heavy	60 min	120 min	180 min	360 min
	Assault, 500 meters against moderate opposition	Fast walk, 6 km/hr	Heavy	20 min	40 min	60 min	120 min
TYPE OF MEDICAL UNIT							
Medical Company	Establish clearing station (able to receive patients)	To be minimally operational:[11]	Moderate to heavy				
		In open area[12]		2.5 hrs[14]	2.5 - 5 hrs[15]	2.5 - 7.5 hrs	7.5 - 15 hrs[16]
		In wooded area[13]		3.5 hrs	3.5 - 7 hrs	3.5 - 10.5 hrs	10.5 - 21 hrs
		For entire clearing station to be operational:	Moderate to Heavy				
		In open area		5.5 hrs	5.5 - 11 hrs	5.5 - 16.5 hrs	16.5 - 33 hrs[16]
		In wooded area		6.5 hrs	6.5 - 13 hrs	6.5 - 19.5 hrs	19.5 - 39 hrs
TYPE OF SIGNAL UNIT							
Signal Bn	Establish communications (VHF) between DIV Main, Div Arty, Tac CP, and forward Brigades (Each link a 12 channel system)	Minimum number of links to "fight the war"	Heavy	2 hrs max	4 hrs max	6 hrs max	12 hrs max

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

Table 3-4. PERFORMANCE DEGRADATION DATA FOR SPECIFIED UNITS IN A CW ENVIRONMENT[2] (Cont'd)

	Major Function	Description	Workload	Times Required to Accomplish Functions W/O Protective Clothing*	While in MOPP 4 (Full Protective Ensemble) @20°F(-7°C)	@50°F(10°C)	@85°F(29°C)
		Complete	Heavy	12 hrs max	24 hrs max	36 hrs max	72 hrs max
	FM Station (Div - CG Cmd Net and Ops/Intel Net)	Set up station					
		w/RC-292 antenna	Heavy	.5 hr	1 hr	1.5 hr	3 hrs
		w/whip antenna	Heavy	15 min	30 min	45 min	1.5 hr
		Get into net					
		w/RC-292 antenna	Heavy-moderate	1 hr	2 hrs	3 hrs	6 hrs
		w/whip antenna	Heavy - moderate	.5 hr	1 hr	1.5 hr	3 hrs
	RATT Station, w/double antenna	Set up staion	Heavy	.5 hr	1 hr	1.5 hr	3 hrs
		Get into net	Heavy-moderate	1 hr	2 hrs	3 hrs	6 hrs
	Lay cable within Div Main Area (from Patch Panel (SB611)	Cable (26 pair)	Heavy	4 hrs max	8 hrs max	12 hrs max	24 hrs max
		Wire (1 pair)	Heavy	2 hrs max	4 hrs max	6 hrs max	12 hrs max

*Assuming normal duty uniform and relatively ideal conditions of daylight, moderate weather, trained troops, etc. (unless otherwise specified).

TABLE 3-4 EXPLANATORY NOTES

1. Time for the fire mission refers to the time elapsed between the moment the battery receives the fire mission until the rounds have been fired. Does not include time of flight.

2. Emergency site occupation is a physical move of about 500 meters performed under emergency conditions. Times given refer to the time elapsed between the moment the lead vehicle has entered the new site until the unit is able to commence operations.

3. Deliberate site occupation is a physical move of about 7km performed under tactical conditions. Times given refers to the time elapsed between the moment the lead vehicle has entered the next site until the unit is able to commence operations.

4. Emergency site displacement is a physical move of about 500 meters performed under emergency conditions. Times given refer to the time elapsed between the moment the order to move is given until the first vehicle has entered the new site and include movement time.

5. Deliberate site displacement is a physical move of about 7km performed under tactical conditions. Times given are the same as explanatory note 3.

6. Unit operates with OH-58, UH-1, and AH-1S aircraft. Unit will also have UH-60 and EH-1H aircraft which are treated separately with respect to maintenance.

7. For UH-1, OH-58, and AH-1S.

8. Total down time of 72 hours with more than one mechanic working.

9. Consists of 3 platoons of 3 squads each. Squads use one M113 (APC) + 1.5-ton trailer; 8 men.

10. Knock down banks, grades, add gravel, etc.

11. Minamally operational medical company clearing station includes a receiving and disposition area, emergency treatment area, one OR, CMS, laboratory, X-ray, and one ward.

12. Open area means flat ground that does not require further preparation.

13. Wooded area means light underbrush that must be cleared but trees do not have to be removed. Times do not include that required for camouflage, or installing stoves and flooring.

14. If areas not previously reconnoitered, add 0.5-1 hour to times.

15. Shorter time based on moderate workload; longer time (computed) based on heavy workload. (Applies to all time ranges given).

16. Add 25-30% more time for those poritons of operations conducted at night.

3.1.3 Need for collective protection.

In order to continue sustained operations on the integrated battlefield, there is a need for some form of unit CP. Marines cannot operate indefinitely in chemical-protective equipment (MOPP). Unit chemical protection will include utilization of CP equipment (CPE) in shelters, buildings, temporary structures, and selected combat vehicles as well as provision of overhead protection of equipment, supplies, and personnel from liquid agent attacks. CPE is required for those units that must remain in contaminated areas, and in those fixed installations such as airfields and logistical support areas which are prime P agent targets.

The purpose of CP is to provide a protective environment in which (1) individuals can carry out tactical functions efficiently without the encumbrance of individual chemical and biological protective equipment; (2) individuals can find relief from wearing individual protective equipment, and can eat, sleep, and perform personal hygiene; and (3) a clean area is provided for key personnel in case of chemical attack. Typical tactical situations requiring CP are found in command posts, communications centers, fire-control stations, missile-control complexes, medical and hospital complexes, and rest-and-relief stations.

It may be necessary also to provide protection for certain tactical equipment. The complexity and possible vulnerability of electronic equipment may make the equipment itself the prime target of an attack. The potential corrosive action of smoke and other common agents, or the employment of antimateriel agents could render the equipment inoperable or cause it to malfunction.

3.1.4 Special considerations for amphibious operations.

As stated in LFM-01, amphibious assault is characterized by the build-up of combat power ashore from an initial zero capability to full, coordinated striking power. The success of such an endeavor is dependent on an uninterrupted flow of men and equipment in accordance with the landing schedule. Once initiated, assault must be relentlessly pursued.

Planning to cover the eventuality of an enemy NBC attack during the critical ship-to-shore phase requires the following actions to ensure compliance with the landing schedule:

- Full MOPP posture for tactical air (particularly AV-8 and OV-10 crews), helicopter, and seaborne personnel must be maintained if previous enemy chemical agent use is ascertained or if intelligence indicates enemy intent to use chemical agents.
- Medication to minimize motion sickness of embarked assault personnel in full MOPP posture. Motion sickness to masked personnel presents potentially hazardous risks.

The situation faced by Marines during amphibious operations is unique in that they must establish an initial "toe-hold" against defending enemy forces capable of short-notice reinforcement. From this initial, controlled piece of terrain, however restrictive it may be, the Marines must continue the initiative in order to expand the force beachhead line (FBHL) inland so that follow-on forces can come ashore and increase the friendly firepower capability. As this is being accomplished, all Marine forces remain within enemy mortar, artillery, and rocket range for a considerable period of time. During this time, Marines are continuously at risk to

enemy surface-to-surface delivered chemical munitions. In such an environment, MOPP4 level will be required for prolonged periods of time. Therefore, even during the initial stages of the amphibious assault, some form of CPE must be available in order to sustain operations and continue the mission. Due to the concentration of units in the FBH and the quantity of NBC weapons that threat forces can employ, some units will become contaminated regardless of efforts to limit contamination.

This necessitates a requirement for some type of CP that will allow personnel to conduct necessary functions in a protected, nontoxic environment, without utilizing individual protective ensembles during and after release of CW or BW agents. CP is required because use of individual, protective equipment hampers many work functions and because the persistency of some agents may be greater than the time span an individual is capable of functioning effectively in the individual protective ensemble.

In typical wing/squadron operations, once the air unit moves to land-based operations, it may have to continue operations in a high CW threat area. If the operational area (AO) becomes contaminated, the air unit most likely will continue operations from the same location within the contaminated area. According to the mission requirements, most work functions will be accomplished by personnel wearing individual protective ensembles. However, collective protection should be used by wing/squadron for essentially three different purposes and which are described as follows:

- "Functional" shelters will be used wherever necessary to provide a nonrestricted environment for certain critical work functions (command post, communications, crew alert, and so forth). This is a minimum ingress/egress facility.

- "Rest" shelters will be used to provide a place for personnel (aircraft maintenance, security police, disaster control, and so forth) returning from duties in a chemical biological environment, to attend to their personal needs (eat, drink, sleep). This is a maximum ingress/egress facility.
- "Survival" shelters will be used for other personnel solely to keep them alive. This is also a minimum ingress/egress facility.

For the remainder of the MAGTF, some CP, to a certain degree, will be required in order that the following functions can be performed in the contaminated environment previously described:

- Combat service support
  - C^3
  - Maintenance
  - Medical/dental facilities
  - Health and comfort facilities
- Combat support units
  - C^3
  - Combat vehicle systems
  - Health and comfort facilities
- Combat units
  - Health and comfort facilities

In the remaining sections of this chapter, the above requirements will be addressed in more detail and presented with justifying experiential analysis. An operational concept for collective protection and requirements to implement the concept will be delineated.

3.2 COLLECTIVE PROTECTION

3.2.1 CP systems.

As stated in the introduction, individual protection against chemical and biological hazards consists essentially of wearing protective clothing and equipment. However, these items cannot be worn indefinitely. If they desire, the threat forces will be able to subject an area occupied by friendly forces to a hazardous concentration of chemical agent for a prolonged period. Therefore, it is necessary to be able to provide some means of CP against chemical hazards to permit personnel to take care of their personal needs and to continue their various field activities

The purpose of CP is to assist in alleviating the strains of prolonged NBC operations on the battlefield. Everyday functions, such as shaving, eating, and sleeping will be difficult for personnel in their individual protective equipment. Full individual protective equipment (mask and protective clothing) will produce physiological and psychological strains on personnel. These strains, in conjunction with heat loading of the body, may seriously degrade a unit's combat effectiveness. To prevent this loss of combat effectiveness, an NBC-free atmosphere may be necessary to allow personnel to rest and relax. Therefore, CP must provide a protective environment which meets the following requirements:

- Where individuals can carry out those military functions that cannot be done efficiently with the encumbrance of individual protective equipment.
- Where individuals can find relief from wearing individual protective equipment, and where they can eat, and perform personal hygiene.

- Which can be used as a safe area for key personnel in case of CB attacks.

The United States currently utilizes the following two types of collective protection as follows:

- The first type of CP includes a positive pressure system. This system is essentially the protection of an enclosed area against hazardous concentrations of airborne agents. The enclosure may be a building, an underground shelter, a portable shelter, a van, or a vehicle. CP is generally achieved by pressurizing the enclosure with air that has been filtered, or otherwise treated to remove airborne contaminants. Pressurization of the enclosure precludes the penetration of outside airborne contamination through leakage sources. Air purification is normally achieved by forcing the contaminated air through particulate and gas filters. Entry and exit of the protected enclosure is accomplished by the use of an airlock-type protective entrance.
- The second type of CP consists of the ventilated face-piece method of protection which supplies filtered air to individual protective masks, and relieves the individual of the normal breathing resistance found in conventional protective masks and filters. This type of CP is normally used in combat vehicles for the protection of crewmembers or to provide protection to a small number of patients (six persons) at a medical facility.

The various types of CP that can provide the required protective environment can be categorized as follows:

- Collective protection shelters (CPS)
- Modular collective protection equipment (MCPE)
- Collective protection equipment (CPE) for combat vehicle systems
- Special collective protection

CPSs are shelters that exclude chemical agents (normally by the positive pressure method) so as to provide rest and relief for personnel who must hold specific, limited areas of critical terrain, and for operations of command, communications, and other important facilities. The CPE is designed to provide protection to crew members and individual passengers on select vehicles and can be either positive pressure, ventilated facepiece or a combination of the two. The modular collective protection, (MCP), is essentially protection of vans (for example, those used for air defense, communications, data processing, and fire direction) converted into collective protection shelters by adding modular filter, pressure, and air-lock kits. And finally, special collective protection is designed for combat service support units which do not move frequently, but instead usually operate from shelters. It serves the same function as modular systems but is more difficult to set up, or take down and move.

3.2.2 CP shelters.

CP shelters are basically classified as ventilated or unventilated, either of which can be permanent or improvised. Portable CP equipment systems are used by command, communications, and other vital functional elements. A protective shelter is any enclosure that protects the occu-

pants from the hazards of NBC contaminants in vapor, aerosol, or particle form.

- Ventilated shelters. This type of shelter is equipped with gas-particulate filter units and airlock entrances and exits. A filter unit pumps filtered air into the shelter providing agent-free air and building up a positive pressure within the shelter. This type of shelter can be provided by using bunkers, pillboxes, armored personnel carriers, or various types of portable CP shelters.
- Unventilated shelters. This type of shelter is based on the concept of trapping uncontaminated air within the enclosure before the atmosphere becomes contaminated. The shelter must be airtight and all openings must be sealed as long as the hazard exits. Calculated stay time for shelter occupants (before the air becomes stagnant) varies with several factors.
- Permanent shelters. This type of shelter is constructed by or with the assistance of engineer personnel according to prescribed standards, usually for specially designated installations in areas where conditions are relatively static.
- Improvised shelters. This type of shelter is constructed by the using unit from available material. These materials may range from nothing more than logs and dirt to lumber and bricks, and might be used to build a new shelter or convert an existing structure into a shelter. Using units may request assistance from available engineer units.

- Portable CPE systems. These include the M14 CPE to be used with the M291A2 and M820 expandable van trucks, the M10 CPE to be used with the battery control center of a HAWK missile battery, and the M51 positive pressure CP shelter. The M51 includes a protective entrance that allows contamination-free entrance and exit when proper procedures are used, and it is collapsible to permit stowing. Additional tentage would be required in order to provide overhead cover for dressing and undressing, and to maintain light discipline for 24-hour operations.

3.2.3 Location and design of CP shelters.

CP shelters are located, if possible, as follows:

- Where they are readily accessible to personnel who may need to reach shelter quickly.
- Where they provide protection against high explosives as well as CB agents.
- Where high concentrations of chemical agents are not likely to accumulate.
- On well-drained, firm soil.
- Underground and well camouflaged.

Shelters are designed as follows:

- To eliminate drafts and prevent seepage of chemical agents.
- So that they are covered with at least one meter of earth or sandbags, if underground. If the shelter is above ground all joints and cracks should be sealed and floors should be made airtight.

- With openings around piping, conduits, ventilators, or chimneys stopped up or altered so that they can be closed.
- So that the structure also offers maximum resistance to high explosive blast and missile penetration.
- With an entrance airlock and an emergency exit.
- With space provided for lights, water, first aid kit or equipment, shaving facilities, and latrine (or outside latrine).
- With provision for communications to the outside.
- So that they are airtight or can maintain a positive pressure in the shelter.
- So that personnel can decontaminate themselves, if necessary, before entering the shelter proper.

3.2.3.1 Construction characteristics.

It is anticipated that an integrated battlefield situation precludes the Marine Air Ground Task Forces (MAGTFs) digging an underground shelter, and that construction of a complete above-ground shelter may not be feasible, especially in a mobile environment. Instead, MAGTFs must modify any existing structures or utilize authorized equipment to provide CP. An improvised shelter should be constructed as strongly as possible to provide bomb and blast resistance as well as NBC protection. Structures considered suitable for the integration of NBC protection include for the integration of NBC protection include buildings, (factories, hospitals, and dwellings) tunnels, caves, basements/cellars, and bunkers.

Construction characteristics of both the unventilated and ventilated structures are discussed below:

3.2.3.2 The unventilated shelter. This shelter consists of an entrance, airlocks, main shelter room, and an emergency exit.

- Entrance. The entrance must provide protection against rupture of the airlock entry doors. This may be accomplished by building the entrance with three 90-degree turns (see figure 3-2) or with three baffle walls (see figure 3-3).
- Airlocks. In an unventilated system, airlocks serve as protective barriers against penetration of NBC agents. A double airlock system should be provided to ensure maximum protection. Airlocks should never be considered suitable to allow entry and exit once an NBC environment is established.
- Main shelter room.
- Emergency exit. An emergency exit must be provided should the primary entrance become damaged.

3.2.3.3 The ventilated shelter. This shelter utilizes an interior over-pressure to prevent NBC-agent penetration. Gas-particulate filter units provide air that is free of NBC agents for ventilation and pressurization. Existing facilities need not be completely airtight, but must be sealed to allow pressurization with the rated filter output. Figure 3-3 shows an improvised ventilated shelter. This shelter consists of:

- Main shelter room. The use of air control devices allow for controlled leakage and maintenance of a positive pressure inside the main shelter room.
- Airlocks. The airlocks also must have air control devices to maintain pressurization and prevent contamination when personnel enter or exit the shelter.
- Entrance. Entrance requirements for the ventilated shelter are the same as for unventilated systems.

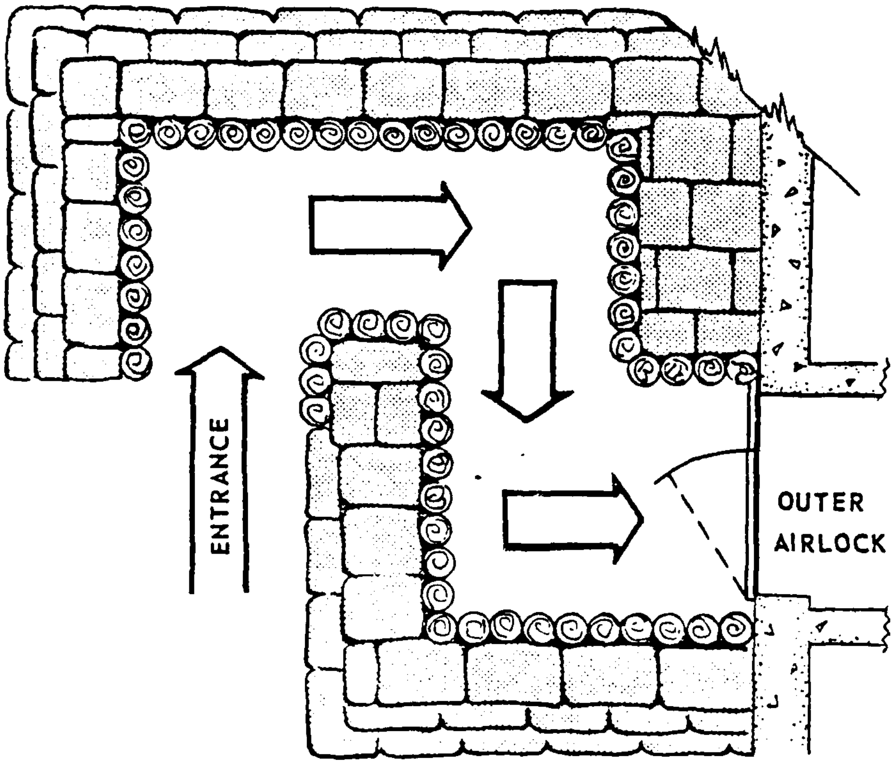


Figure 3-2. Shelter Entrance With 90-Degree Turns

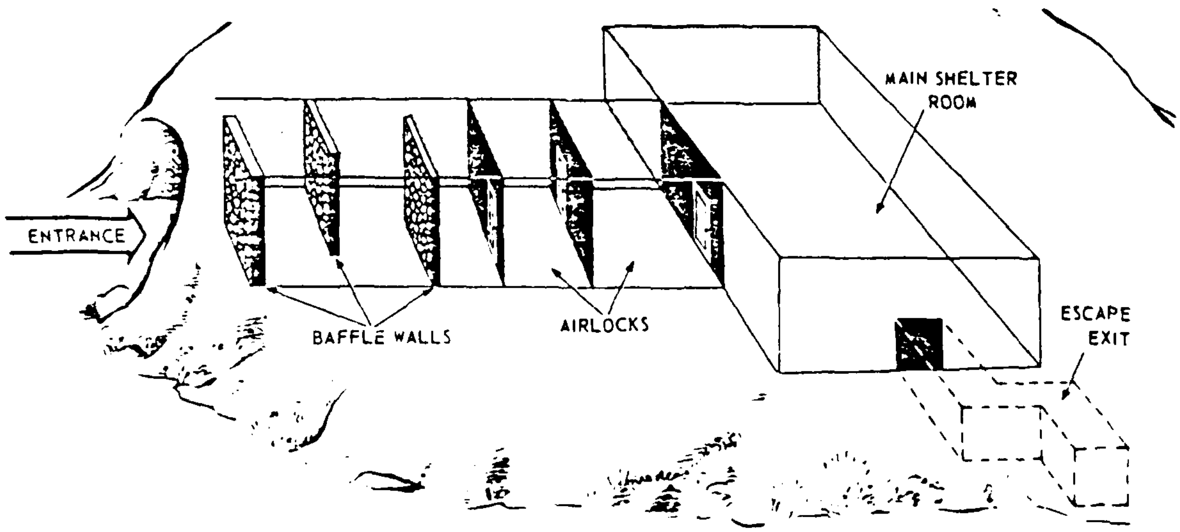


Figure 3-3. Shelter Entrance With Baffle Walls

- Emergency exit. Emergency exit requirements are the same as for the unventilated shelter.

3.2.4 CP for armored vehicles.

The armed services are reviewing their requirements for CP systems for the armored vehicles as a result of Congressional direction to the U.S. Army. Those of interest to the MC are shown in table 3-5. The following CP systems are being considered:

- Positive pressure
- Ventilated facepiece
- Hybrid
- Total

A brief explanation of these four systems is provided in the following paragraphs, and an example of their application is shown in figure 3-4.

3.2.4.1 Positive pressure system. This system is designed to provide a clean environment within which personnel can operate free of any encumbrances such as protective masks and protective clothing. Prime concerns in a positive pressure system are the maintenance of a positive pressure and a clean environment within the weapon system of interest. Detection and decontamination of NBC contamination are important in this system. Detection of contamination outside of the positive pressure system will warn occupants to remain within and look for another location should exit of the vehicle be necessary. If exit is required in a contaminated area, appropriate protection must be worn. As for decontamination, requirements are non-existent as long as the integrity of the system is maintained. However, should hatches/doors be opened in a contaminated environment, then a risk of contaminating the inside of the vehicle is incurred. Determination of this interior contamination must be made,

Table 3-5. NBC Protection Systems and Vehicles

Vehicle	Individual Protection	Ventilated Facepiece	Positive Pressure	Hybrid	Total
Landing vehicle tracked (LVT7A)	X	X		X	
Tanks (M551, M48, M60, and XM1)	X	X		XM1 MKI	
Mobile Protected Weapons System (MPWS)	X	X		X	
Self-propelled artillery howitzers (M109 and M110)	X	X			
M109 nuclear shop van	X			X	X
General support rocket system (GSRS)	X	X			
Forward area alerting radar (FAAR)	X	X		X	X
AN/TSQ-73	X		X		X
Hawk/I-Hawk (vans) light anti-aircraft missile (LAAM)	X		X	X	
M578 recovery vehicle (light)	X	X			
M88/M88A1 recovery vehicle	X	X			
Tacfire	X		X		X
Combat support vehicle (CSV)	X				
Universal engineer tractor (UET)	X	X			
Tri-tac, S280 shelters	X		X		X
Tactical satelite communication shelter, S250 and S280	X		X		X
Other S250 and S280 shelters (TCC, TRC, TSQ, SB)	X		X		X

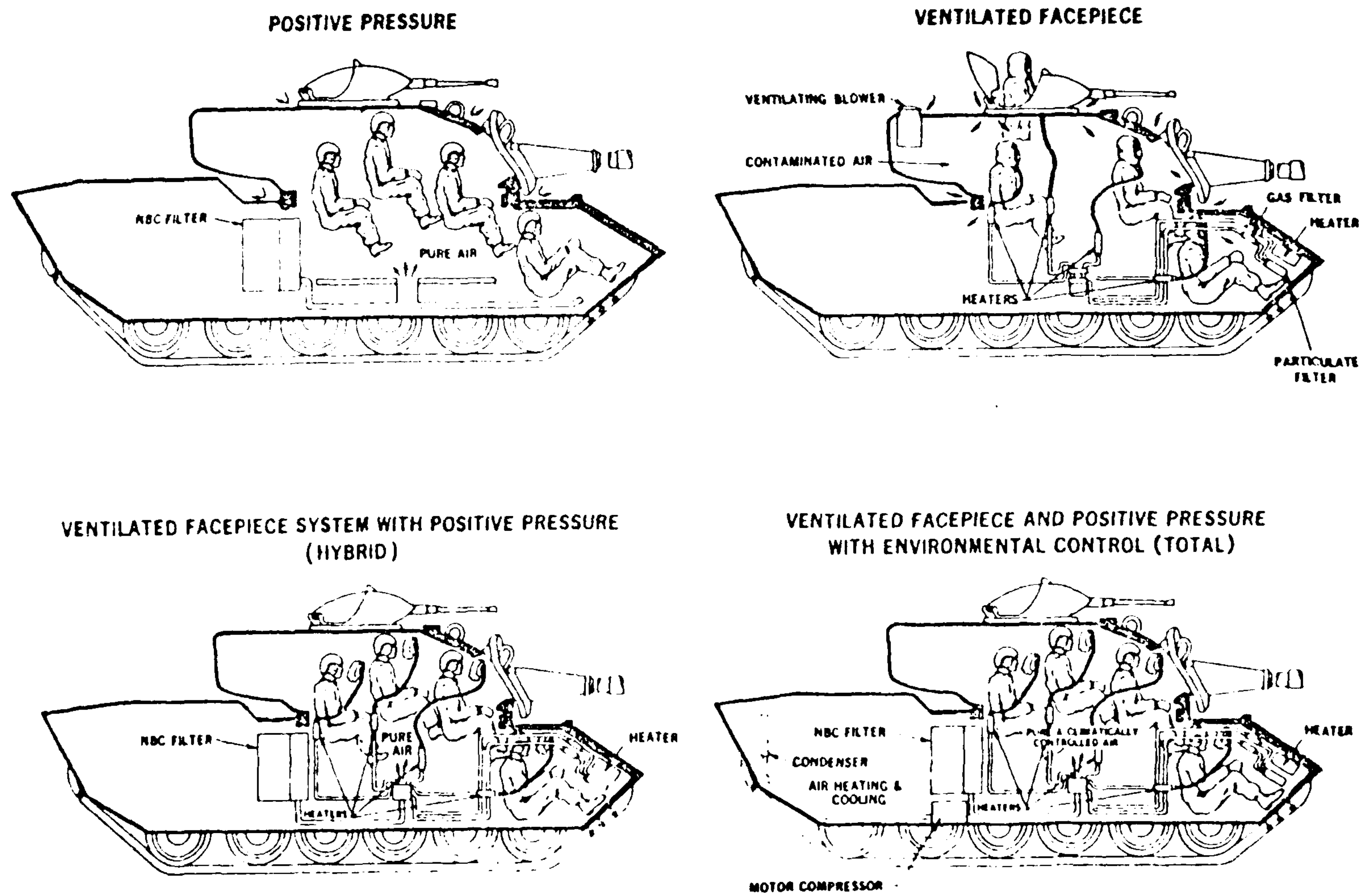


Figure 3-4. NBC Protection Systems for Combat Vehicles

and--if contamination exists--extensive decontamination must be done prior to reuse of the positive pressure system, or individual protection must be relied upon, or time must be allotted to purge the contamination (if in vapor form). If positive pressure systems are to be effective in an NBC environment, doctrine must demand that mounted personnel operate totally from within weapons systems having the positive pressure. Such weapons systems would be those that have relatively static missions, wherein personnel remain for extensive periods of time, and for which rapid entry/exit is not critical.

3.2.4.2 Ventilated facepiece system. This system provides forced air, which has been circulated through a gas-particulate filter unit, to a number of outlets. Personnel can connect their protective masks to these outlets via a tube with a quick connect/disconnect feature. This system permits the user to have some flexibilty at his position on the vehicle, and at the same time eliminates any breathing resistance encountered with the individual mask. If the individual needs to leave his position, the quick disconnect hose can be attached to a separate filter canister. The ventilated facepiece system requires that the individual wear his chemical protective ensemble for whole body protection. Implicit here is that decontamination of the interior of the vehicle during mission performance is not a concern. Indeed, detection of contamination areas outside of the vehicle is not a concern; however, should the vehicle be exposed to contamination, it must be decontaminated thoroughly prior to being taken to a "clean" area--such as a depot--otherwise, the vehicle could serve as a source of contamination. Personal decontamination must also be considered. Liquid chemical contamination will penetrate or degrade the

protective ensemble and vapors from the contamination provide a respiratory hazard. In terms of operations, the ventilated facepiece system allows the crew members and passengers to perform their missions (as defined within current U.S. tactics and doctrine) with armored fighting vehicles that require mobility, maneuverability, and flexibility of optimum operation.

3.2.4.3 Hybrid system. The hybrid system combines both the positive pressure and ventilated facepiece systems in one. The positive pressure portion of the system provides protection until the vehicle seal is broken, due to required entry/exit or any other reason. At that time the ventilated facepiece portion of the system becomes the primary collective means of protection. Application of the hybrid system provides extensive protection in that it allows a transition from positive pressure to ventilated facepiece. Detection of contamination is significant only if the integrity of the positive pressure system has not been compromised. However, once it is compornised, the positive pressure system cannot be used again until the vehcile interior is determined to be clean or has been thoroughly decontaminated. Therefore, the personnel in the vehicle must rely on ventilated facepieces and individual protection systems in order to continue operations.

3.2.4.4 Total system. This system provides for an environmental control unit (that is, air conditioning) along with the positive pressure of the hybrid systems. The system is designed so that the environmental control unit normally receives air that has been filtered for NBC contamination. Environmental control units are usually found with weapons systems that have temperature sensitive components requiring a certain temperature

range for proper operation. Operational situations for the total system in an NBC environment are similar to those posited for the positive pressure systems--once contamination has occurred. The interior of the vehicle must be decontaminated, or the air must be purged (vaporous contamination), otherwise, individual protection must be relied upon; also, detection of contamination outside of the vehicle is important.

3.2.5 Current U.S. CP equipment. Currently, there is a limited amount of CP equipment available to United States military forces. The CP items available include the M6, M6A1 300 cubic feet per minute (CFM), gas-particulate filter unit (GPFU); the M8A3, 12 CFM GPFU for combat vehicles; the M7A1, 6 persons, 12 CFM, GPFU; the M14 GPFU; and the M13, gas-particulate filter unit for armored vehicles. The Services have other equipment for field operations as well as items to convert existing facilities to CP shelters. Table 3-6 lists current United States CP equipment. This U.S. CPE was evaluated for USMC use as well as allied CPE from data collected during a visit to Europe concerning CPE utilized by various United States allies in Europe and Israel. A total of 16 items of allied CPE was reviewed and evaluated for this study (details of these items were provided in the first interim report); however, none were found which meet USMC needs better than U.S. CPE.

3.3 CURRENT CP CAPABILITIES OF A MAGTF

3.3.1 Current CP inventory

A review of the USMC table of authorized materiel (TAM), indicates that there is a severely limited amount of CPE available to the MAGTF. The items authorized are shown on table 3-7.

Table 3-6. United States Collective Protective Equipment

Country, Service	Item	Cost	Allocation	Cube/Weight	Power Source	Remarks
U.S. Army	M46 GPFU	**	**	94.5/1500	220 V/3 phase, 160 Hz	For use in improvised shelters. Electric motor driven (EMD). Provides 600 CFM.
	M6/M6A1 GPFU	1302.00	**	**	1½ HP gasoline engine	Field shelter use.
	M8A3 GPFU	1202.00	One per specific vehicle	Considered subcomponent of vehicle	Vehicle power, 24 V	4 crew protection for combat vehicles, the M48A5 tank, M88/M88A1 recovery vehicle and M551/M551A1 armored reconnaissance/airborne assault vehicle.
	M13/M13A1 GPFU	2290.00	One per specific vehicle	Subcomponent	Vehicle power, 24 V	XM1/M60 tanks and M723 combat engineer vehicle.
	M[illegible]A1 GPFU	**	**	**	115 V AC converted to 30 V AC	5 person, hospital. Provides 12 CFM.
	M14 GPFU	**	One per M113A1 armored ambulance	**	Vehicle power, 24 V	7 person; armored ambulance, M291A2 and M820 expansible van trucks. Provides 12 CFM.
	M51 inflatable CP	37000.00	2 per battalion aid station; 8 per division medical battalion	781/5400	20 HP gasoline engine	Weight includes the M105A2; 1½ ton trailer, shelter protective entrance, and recirculation unit.
	M56 modular collective protection equipment (MCPE)	8384.00	**	23/214	208 V, 400 Hz, electric motor	1 filter unit. Provides 200 CFM of filtered air.
	M59 MCPE	9034.00	**	30/276	208 V, 400 Hz, electric motor.	2 filter unit. Provides 400 CFM of filterel air.
	M10 MCPE		2 per Hawk BCC	24/214	Electric motor, 416 V/400 Hz	Battery control center (BCC) of a Hawk missile battery.
U.S. Navy	M6A1 GPFU	1302.00	Determined by each activity	37/705	1½ HP gasoline engine	For improvised shelters, provides 300 CFM of filtered air.
U.S. Air Force	KMU450	70000.00	US air bases, Europe	Unknown	160 cycle/3 phase/120/208 V	EMD, for use in operations command centers.

**This information is being obtained from other Services and has not been in time for inclusion in this table.

Table 3-7. USMC Collective Protection Equipment

Item	Cost	Allocation	Cube/Weight	Power Source	Remarks
M6/M6A1 gas particulate filter unit (GPFU)	1302.00	None listed*	37/705	1½ HP gasoline engine	For use with field shelters. Provides 300 cubic feet per minute (CFM) of filtered air.
M8A3 GPFU	1202.00	1 per M48 tank	Considered subcomponent of tank	Vehicle power, 24 V	4 crew positions; provides filtered air to ventilated face masks (M25 protective mask). Provides 12 CFM.
M13/M13A1 GPFU	2290.00	1 per M60 tank and LVTP7	Considered subcomponent of vehicle	Vehicle power, 24 V	5 crew positions vice 4. Operation identical to M8A1. Used on LVTP7 and M60 tank. Provides 12 CFM.

*The M6 GPFU is listed in the item data file (IDF) as being combat essential but an allocation for units not shown.

The TAM, revision number 5, was reviewed to find any materials that could be used for CP, although they were not intended for that purpose. There are no items listed in the TAM that meet this requirement without modification. However, items such as electronic maintenance shelters and shops, TOW and DRAGON maintenance vans, radar vans, and air conditioning units may be compatible with MCPE being developed. It was the limited amount of CPE authorized, as well as the vague doctrine and guidance on its use, that led to the assessment of marginal for this NBCD area in the NBCD readiness report (cited on page 2-15).

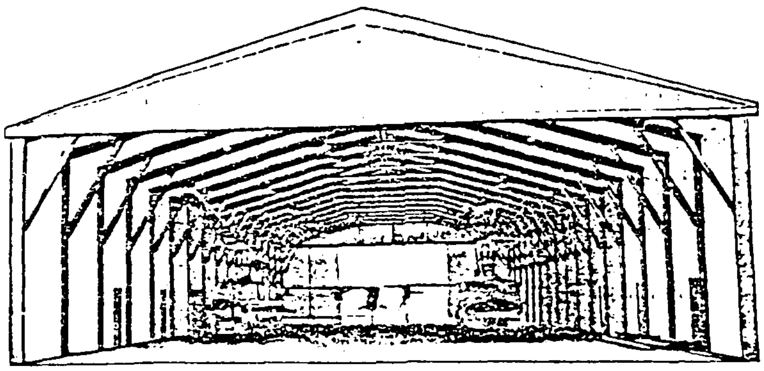
3.3.2 The shelter system. In assessing USMC capabilities for CP for this study, the Marine Corps Expeditionary Shelter System (MCESS) was evaluated. The MCESS contains three large shelters which have a total of five configurations; four small shelters which include one knock-down, two electromagnetic interference shieldings, and a rigid mode; and a joining corridor. There are also three small shelter complexing kits designed to provide weatherproof seals when shelters are joined together. Table 3-8 shows the areas of the MCESS that may impact on CP adaptability. The

Table 3-8. Marine Corps Expeditionary Shelter Systems

Shelter	Roof	Walls	Flooring	Heating	Air conditioning	Dust Protection	Power Supply	Use
60'x128'	Steel	Steel panels	None	Optional	None	Earth floor	60Hz, 120/208V, 100A, single phase	Hangar supply/storage
32'x73'	Steel	Steel panels	None	Optional	None	Earth floor	60Hz, 120/208V, 100A, single phase	Supply/storage maintenance
20'x33'	Steel	Steel panels	None	Optional	None	Earth floor	60Hz, 120/208V, 100A, single phase	Unit maintenance/storage
8'x8'x20' Knockdown	Aluminum frame	Aluminum frame	Aluminum frame	Required	Optional, access through endwall	Yes	60Hz, three phase, 120/208V, 6A	Unit operations
8'x8'x20' Rigid	Aluminum frame	Aluminum frame	Aluminum frame	Required	Optional, access through endwall	Yes	60Hz, three phase, 120/208V, 6A	Unit operations
8'x8'x10' Electromagnetic interference shielding	Aluminum extrusion	Aluminum extrusion	Aluminum frame	Required	Required	Yes	60Hz, three phase, 120/208V, 6A	Unit operations
8'x8'x20' Electromagnetic interference shielding	Aluminum extrusion	Aluminum extrusion	Aluminum frame	Required	Required	Yes	60Hz, three phase, 120/208V, 6A	Unit operations
7'x7'x11' Joining corridor	Aluminum extrusion	Aluminum extrusion	Aluminum extrusion	None	None	Yes	None required	Unit operations

following paragraphs describe the shelters and components that make up the MCESS.

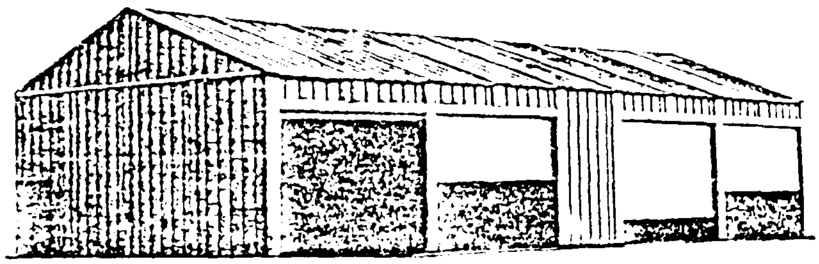
3.3.2.1 The 60 foot by 128 foot shelter. The 60 foot by 128 foot shelter is constructed of steel panels and roof, and is without flooring. The shelter does not have dust protection or air conditioning, and heating is optional. The shelter is designed for two configurations--supply/storage and as a hangar. The hangar configuraton is shown in figure 3-5.



CONFIGURATION A (HANGAR)
CONFIGURATION B (SUPPLY/STORAGE)

Figure 3-5. 60 Foot by 128 Foot Shelter

3.3.2.2 The 32 foot by 73 foot shelter. The 32 foot by 73 foot shelter is constructed like the 60 foot by 128 foot and is intended to be used as supply/storage and maintenance buildings. Figure 3-6 shows the maintenance configuration.



CONFIGURATION A (SUPPLY/STORAGE)
CONFIGURATION B (MAINTENANCE)

Figure 3-6. 32 Foot by 73 Foot Shelter

3.3.2.3 The 20 foot by 33 foot shelter. The 20 foot by 33 foot shelter is also constructed of steel panels and roof, and does not have flooring. This shelter is designed for unit maintenance and storage is shown in figure 3-7.

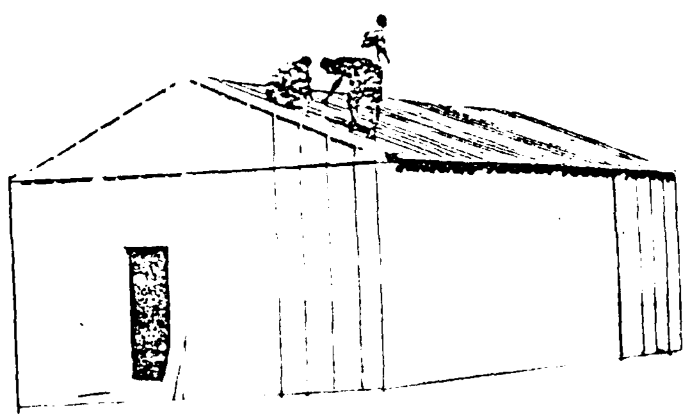


Figure 3-7. 20 Foot by 33 Foot Shelter

3.3.2.4 The 8 foot by 8 foot by 20 foot shelter. The 8 foot by 8 foot by 20 foot knockdown shelter is constructed of aluminum frame roof, walls, and floor, and will have heating, dust protection, and optional air conditioning. The side and end walls of this shelter are removable for storage and shipment. These shelters may be used for various military operational functions. Figure 3-8 presents the knockdown shelter concept.

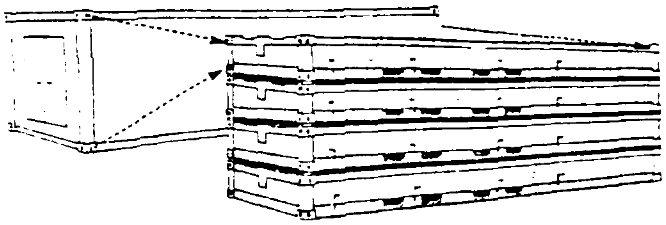


Figure 3-8. 8 Foot by 8 Foot by20 Foot Knockdown Shelter

3.3.2.5 The 8 foot by 8 foot by 20 foot shelter. The 8 foot by 8 foot by 20 foot rigid shelter is constructed like the knockdown shelter. The end wall containing the access panels and emergency escape hatch can be removed. This shelter, shown in figure 3-9, has many uses.

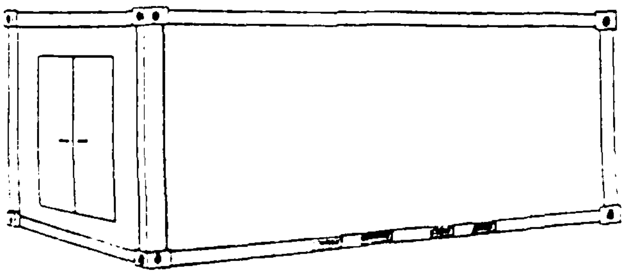


Figure 3-9. 8 Foot by 8 Foot by 20 Foot Rigid Shelter

3.3.2.6 The 8 foot by 8 foot by 20 foot electromagnetic interference (EMI) shelter. The 8 foot by 8 foot by 20 foot EMI shelter is constructed of aluminum extrusion roof/walls and aluminum frame flooring. The EMI shelter cannot be broken down and must be transported fully assembled. This shelter requires heating, air conditioning, and dust protection capabilities and will be configured with electromagnetic equipment. The end wall containing the access panels and emergency escape hatch can be removed. Figure 3-10 shows this shelter.

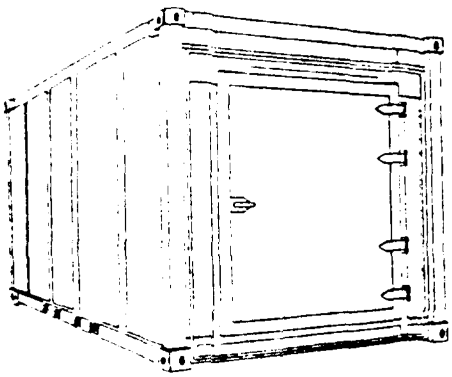


Figure 3-10. 8 Foot by 8 Foot by 20 Foot EMI Shelter

3.3.2.7 The 8 foot by 8 foot by 10 foot EMI shelter. The 8 foot by 8 foot by 10 foot EMI shelter is constructed like the 8 foot by 8 foot by 20 foot shelter and is shown in figure 3-11.

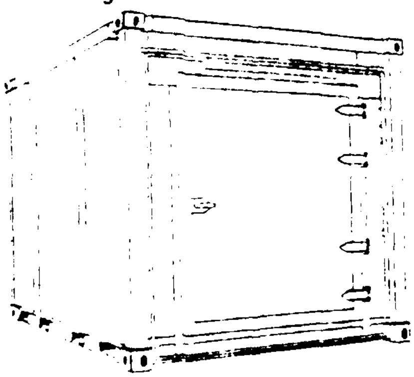


Figure 3-11. 8 Foot by 8 Foot by 10 Foot EMI Shelter

3.3.2.8 The joining corridor.

The joining corridor, 7 foot by 7 foot by 11 foot, consists of a roof, walls, and floor constructed of aluminum extrusions with polystyrene foam cores and three-piece aluminum skins. The joining corridor provides dust protection but no heating, air conditioning, or power supply. These corridors are designed to permit four-way-joining with shelters. The joining corridor is shown if figure 3-12.

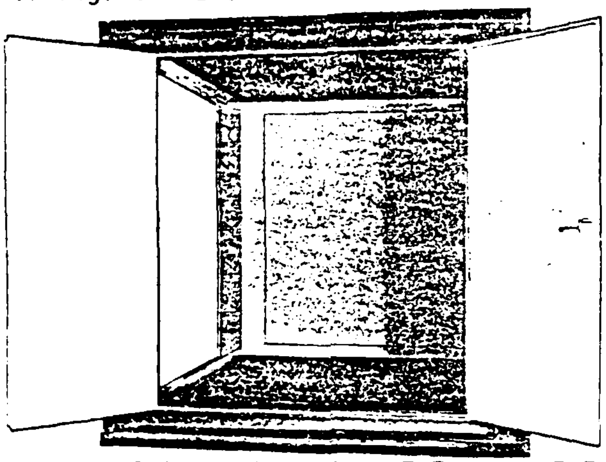


Figure 3-12. Joining Corridor, 7 Foot by 7 Foot by 11 Foot

3.3.2.9 The required operational capabilities (ROC) for MCESS.

The ROC for MCESS states that the small shelter group will include the characteristics "moisture- and dust-protection and minimum protection against chemical and biological agents." The design of the large shelter group precludes the effective sealing of the shelter to provide a component overpressure capability.

3.4 DEVELOPMENTAL CP SYSTEMS

3.4.1 Introduction. Because of the increasing effort in the CW and BW area by Soviet and WP forces, additional intensified interest in better and more efficient CPE has been noted in all the Services. A review of the R&D

efforts of the other Services has identified several items which are in various stages of development. These CP items fall into the following categories:

- Developmental
- Product improvement (PIP)
- Conceptual

Although some of the systems discussed below are not going to be procured by the USMC, the CPE components may have some application for similar USMC items. These categories are listed in table 3-9 and described in detail in the following paragraphs.

Table 3-9. CP Items Important to the MAGTF

Developmental	PIP	Conceptual
MCPE for TACFIRE	M8A3/M13A1 filter Unit	Corona Discharge
MCPE for AN/TSQ-73	ASF engine fixed Filters	
NBC hybrid CPE		
CPE, NBC simplified, XM20		
MCPE applications (vehicles, vans, and shelters)		
Individual CP protection for combat vehicles		
Hardened NBC protection for C^3 shelters		

3.4.2 MCPE for TACFIRE.

3.4.2.1 Description. The concept of modular collective protection equipment (MCPE) provides CB protection against known CB threats for vehicles, vans, and shelters by providing standard items of supply. MCPE consists of filter units (three available), protective entrances (three types), and installation kits (three types). Generally, basic modules are installed external to the protected area with control modules being internal to the protected area. Auxillary electrical cables, connectors, and air ducts are included in the installation kits which permit installation of each particular application. MCPE is designed to provide airflows up to 600 CFM and to operate from 400 hertz, 3 phase AC power.

3.4.2.2 Background.

TACFIRE is a computerized fire support command and control system which frees fire support personnel from many tedious error-prone tasks. TACFIRE provides computerized digital communications, automated processing of data, and rapid dissemination of results.

Collective protection for TACFIRE is required for three types of shelter in divarty (division artillery): display group shelter, divarty processing group shelter, and battalion processing and display shelter. Each shelter requires the M56 filter unit, the M10 protective entrance, and the M262 installation kit. These three items, which provide a capability of 200 CFM of filtered air, are TOE equipment to organizations authorized the TACFIRE system.

3.4.3 MCPE for AN/TSQ-73.

3.4.3.1 Description. Same as paragraph 3.4.2.1.

3.4.3.2 Background.

AN/TSQ-73 (missile minder) is a completely self-contained, automated, easily transportable facility utilized to control and coordinate the activities of NIKE HERCULES, HAWK, and other air defense units. This system will replace the presently deployed AN/MSG-4.

The collective protection capability for AN/TSQ-73 is provided by the M56 filter unit, the M12 protective entrance and the M263 installation kit. These three items, which provide a capability of 200 cfm of filtered air, are TOE equipment to organizations authorized the AN/TSQ-73 system.

3.4.4 NBC hybrid CPE.

3.4.4.1 Description. NBC hybrid collective protection equipment (HCPE) for combat vehicles and related shelters will be utilized to provide positive pressure collective protection and/or individual ventilated facepiece collective protection for a wide variety of present and future combat vehicles and related systems. MCPE offers the flexibility of an over pressure system, a ventilated facepiece system, or simultaneous operation of both systems. HCPE has several features:

- Maximizes NBC protection with broad operational flexibility by allowing closed hatch positive pressure operations or open hatch ventilated facepiece operations.
- Minimizes vulnerability by providing filtered air to the vehicle crew compartment.
- Provides high ventilation flow capability in non-NBC and dust removal in all operational modes.
- Modular design diversifies potential installation/application to combat vehicles.

The basic components of an HCPE system consist of a dust separator, a blower, a gas-particulate filter assembly, a control module, a control or throttling valve, localized ventilation ducts, a ventilated duct, a ventilated facepiece interface and an installation kit. It is anticipated that for Roland, 100 and 300 cfm units will be developed. Target cost -$7,400/install (excluding installation labor) (FY80 dollars).

3.4.5 CPE: NBC, simplified, XM20 (also called SCPE).

3.4.5.1 Description. Collective protection equipment: NBC, simplified XM20, is a system that will be used to convert an interior room of an existing building into a positive pressure CB collective protection shelter where individuals can perform assigned mission in a CB environment without the encumbrance of the protective mask and CB overgarment. The system consists of four components; (1) a CB vapor resistant polyethylene liner, three in a kit, 16 feet in diameter by 10 feet in height for rapidly providing a protected area in an existing structure, (2) a collapsible pressurized protective entrance (PE) which provides an entry/exit capability to the protected area, (3) a filter/blower unit which provides 200 CFM of filtered air both to the liner and the PE, and, (4) a support kit which contains ducting, lighting, sealing, and repair material, loss of power/pressure warning device, and a doorway bib that permits use of the system without the liner in low-leakage rooms such as vaults. The approximate weight for the total system is 500 pounds, requiring approximately 80 cubic feet. Cost is approximately $5,959 in FY81 dollars. The blower unit requires less than 1,500 w and operates on either 110/220 v, 50/60 Hz single phase power. Basis of issue plan for the U.S. Army currently calls for issue of one system to each staff element at battalion

level and higher for use in C^3. The basis of issue for use as rest and relief stations will be one unit per company.

3.4.6 MCPE applications (vehicles, vans and shelters).

3.4.6.1 Description. Modular collection protection equipment (MCPE) consists of a family of end items: three different sized filter units, three different protective entrances, and a static frequency converter. MCPE provides NBC protection by providing filtered air under positive pressure to a variety of vans, vehicles, and shelters (VVS) to prevent the infiltration of toxic chemicals, biological agents and radioactive aerosols. A collapsible protective entrance which is pressurized in the same manner, provides entry/exit capabilities for these vans, vehicles, and shelters. Pressurization is provided by the filter units and is automatically maintained in VVS at 1.2 to 1.7 inches of wg and in the PE at 0.4 to 0.9 inches of wg. The MCPE has the following characteristics: 200 CFM unit on its stand - length 34.6 inches, width 35.5 inches, height 32.5 inches, weight 212.5 pounds; 400 CFM unit on its stand - length 44.81 inches, width 35.5 inches, height 32.5 inches, weight 271.2 pounds; 600 CFM unit on its stand -length 55.0 inches, width 35.5 inches, height 32.5 inches, weight 336.5 pounds; power 1,100, 1,600 and 2,600 watts respectively (208 v as, 3 ph, 400 Hz);cost ($10,400, $11,400, and $12,400) respectively; PE collapsed height - 12.5 inches, width 44.1 inches, depth 50.1 inches; PE erected height - 85.0 inches, width 44.1 inches, depth 50.1 inches, weight 145 pounds, cost $5,300; and the XM5 static frequency converter - height 18.5 inches, width 8.5 inches, length 8.0 inches, weight 62 pounds, cost $9,000.

3.4.7 Individual CB protection for combat vehicles as part of a CP system.

3.4.7.1 Individual CB protection for combat vehicles.

The combat vehicle crewman of 1980 was provided essentially the same type of chemical protective clothing and equipment as his infantry counterpart, with the exception of his mask. He, therefore, experiences the same problems of performance degradation caused by the added weight and bulk of his overgarment, hood, gloves, and boots. However, the vehicle crewman is confronted with two other problems which are aggravated by his mission and are more severe than those of the ground soldier. They are, (1) the threat of combat induced vehicle fires, and (2) an extraordinary level of heat stress when operating during hot climates with hatches closed.

The inability of the overgarment to provide protection when the wearer is exposed to high intensity flame was recognized during testing conducted in the fall of 1978. Shortly thereafter a Product Improvement Program was initiated to flame-harden the overgarment for vehicle crewmen and aviators. The redesigned overgarment incorporates the following improvements:

- The outer shell of nylon-cotton has been replaced by type 457 Nomex.
- The inner foam has been treated with a fire retardant chemical.
- The nylon tricot bonded to the foam has been replaced by a cotton fabric also treated with a fire retardant chemical.

The problem of chemical operations by combat vehicle crewmen in hot climates adversely affects mission performance. Current doctrine dictates that when a tank encounters chemical agents it operates with hatches closed. This accomplishes two things--first it helps to minimize the

possibility of liquid agents contaminating the vehicle interior, and, secondly, it provides an added degree of protection for the crew. While the closing of hatches has obvious advantages, it also introduces a serious problem of heat stress. Available data indicate that with hatches closed in the desert, solar landing and engine heat can cause crew compartment temperatures to exceed 135°F. These elevated temperatures result in excessive seating of the crew which quickly elevates humidity levels inside the tank to the 70-100 percent range. Under such conditions the onset of heat casualties is virtually assured. Even in Europe, an equipment crew compartments will at times become sufficiently hot (during the summer months) to jeopardize mission accomplishment when crews are wearing current chemical protective clothing. To counteract this problem for combat vehicle crewmen, auxiliary cooling system(s) are being developed which allow the creation of a microclimate under the crewman's protective clothing. The following three concepts are being considered:

- The first concept involves the circulation of unconditioned ambient air underneath the protective clothing which enhances the natural evaporative cooling process and greatly increases the stay time of the crewman.
- The second concept also involves the circulation of air underneath the protective clothing; however, in this case the air is conditioned.
- The third concept involves the circulation of conditioned liquid underneath the protective clothing.

Both the second and third concepts allow the crewmen to maintain thermal balance for indefinite periods even when working at high rates under desert conditions. All three of these concepts are being considered because of the space and power requirements for each concept. Depending on the space and power availability for a particular vehicle, one system may prove more effective than the other. By pursuing all three concepts the maximum number of vehicle types can be accommodated.

3.4.8 Hardened NBC protection for C^3 shelters.

The present NBC protection for C^3 shelters has been modified to ensure increased probability of mission accomplishment on the tactical battlefield; including, thermal-blast and fragment threats as well as the NBC environment. A new design for C^3 shelters will interface with the modified total environment control system (TECS), as part of modular collective protection equipment (MCPE). The new C^3 shelters are being fabricated for system testing. The survivability of these new systems will be significantly greater than the present systems.

Approved Army requirements specify that the present C^3 shelter systems cannot survive in the severe hostile environments associated with present and future tactical battlefields. The hardened tactical shelter (HATS) presently in engineering development, has been designed to accomplish the mission after exposure to hostile environments such as nuclear, biological, and chemical; nuclear weapons effects; and conventional fragments. HATS shelters will complement the unhardened S-280 and S-250 shelters.

The MCPE on a typical shelter provides off-the-shelf CP for application to shelters and vans. It consists of a family of end items: a filter unit (three different sizes), a protective entrance, and a static

frequency converter (SFC). Generally, these are external to the protected area, with only a control module internal to the protected area. Auxiliary electrical cables, connectors, and air ducts are included in each of the end items. The MCPE is designed to provide airflows up to 600 cfm.

The vulnerabilities of the current shelter with MCPE and TECS depend on the severity of the hostile threats and their sequence of encounter. As an example, consider the plight of the communications people whose shelter is damaged by a nuclear weapon and then receives a chemical attack. Survivability requires prior coordination and integration of thought and design among the shelter, MCPE, and TECS.

The HATS shelters are designed to withstand any of the stated hostile threats, regardless of the order of exposure, with a minimum of degradation. This protection is provided with a minimum weight impact over current unhardened shelters. The hardened shelters weigh 2,100 pounds (S-280 size) and 1,250 pounds (S-250 size). The weight of the S-280C and S-250 shelters are 1,500 pounds and 782 pounds respectively.

The degree of hardening to be provided in the designs is compatible with the anticipated threat levels which are summarized in table 3-10.

3.4.9 M8A3/M13A1 filter unit PIP.

3.4.9.1 Description. This product improvement project will yield a single gas-particulate filter unit to replace the M7A1, M8A3, and M14 filter units as a means of providing ventilated facepiece protection in tactical vehicles. The improved filter unit will be a compact, self-contained unit consisting of a dust separator, a centrifugal fan, gas and particulate filters, and an air heater. The air heater will be detachable for applications where it is not required. The unit will deliver 4.5 CFM of purified air to the facepiece of an M25 mask and will be suitable for

Table 3-10. Threat Definition

Threat	Level/Features
NBC	Collective protection - positive pressure, resistant paint, location for agent.
Detector/Alarm Systems	
Nuclear	7.3 pounds per square inch (psi) over pressure and associated environments.
Conventional	Fragment - 60 grain, 500 meters per second (mps), no penetration.
Standard	Climatic: Army regulation (AR) 70-39 categories, basic and cold electromagnetic shielding: at least 60 decible (db) attenuation from 0.15 to 10,000 mega hertz (MHz).

either wall or torso mounting. Power for operating the fan and the heater will be the vehicle's 24-VDC supply.

3.4.10 ASF engine fixed filters PIP.

3.4.10.1 Description. The fixed installation filter provides CB protection against known CB material. The fixed installation filter units consist of a roughing filter, a HEPA filter for particulate, and a gas filter. There are three sizes of fixed installation filters; they are the 600, 1,200, and 5,000 CFM gas-particulate filters. The fixed installation filters are of modular construction; however, they are difficult to construct and maintainability consists of replacing the entire assembly. Existing modular design does not permit replacement of components such as

charcoal absorbent or individual filter panels. The PIP redesign includes metal construction, replaceable filter trays (with absorbent refillable capability), better filter bed integrity, and simple maintainability in the field. The project does not include the blowers.

3.4.11 Portable electrostatic CP system. The portable electrostatic collective protection system (PECPS) is designed to provide protection against CB agents. Personnel, equipment, and stored material are contained within a double layered fence which is set up around and above the area to be protected. The overhead is covered with a barrier type material (see figure 3-13). The system is made operational when a generator contained within the structure produces an electrostatic charge through the fence. The fence produces a corona discharge between the screen layers which ionizes oxygen molecules. These ionized oxygen molecules are repulsed through the outer screen by the electrostatic force where they attach to any dust, smoke, or fume in the immediate area. The latter charged particles are then repulsed by the electrostatic field. The open nature of the fence allows light and air to pass through the fence structure, creating a protected, ventilated environment within. This type system, sometimes known as the corona discharge system, is being developed for MCDEC and is scheduled for some testing in FY 82-83.

3.5 CONCEPT FOR CP FOR THE MAGTF

3.5.1 Overall doctrinal concept.

NBC contamination causes casualties and reduces the effectiveness of individuals and units. In addition to producing casualties, chemical agents can greatly reduce individual/unit operational efficiency. Included in the loss of unit capabilities are the effects on individuals of heat buildup due to the assumption of higher levels of MOPP, plus the loss

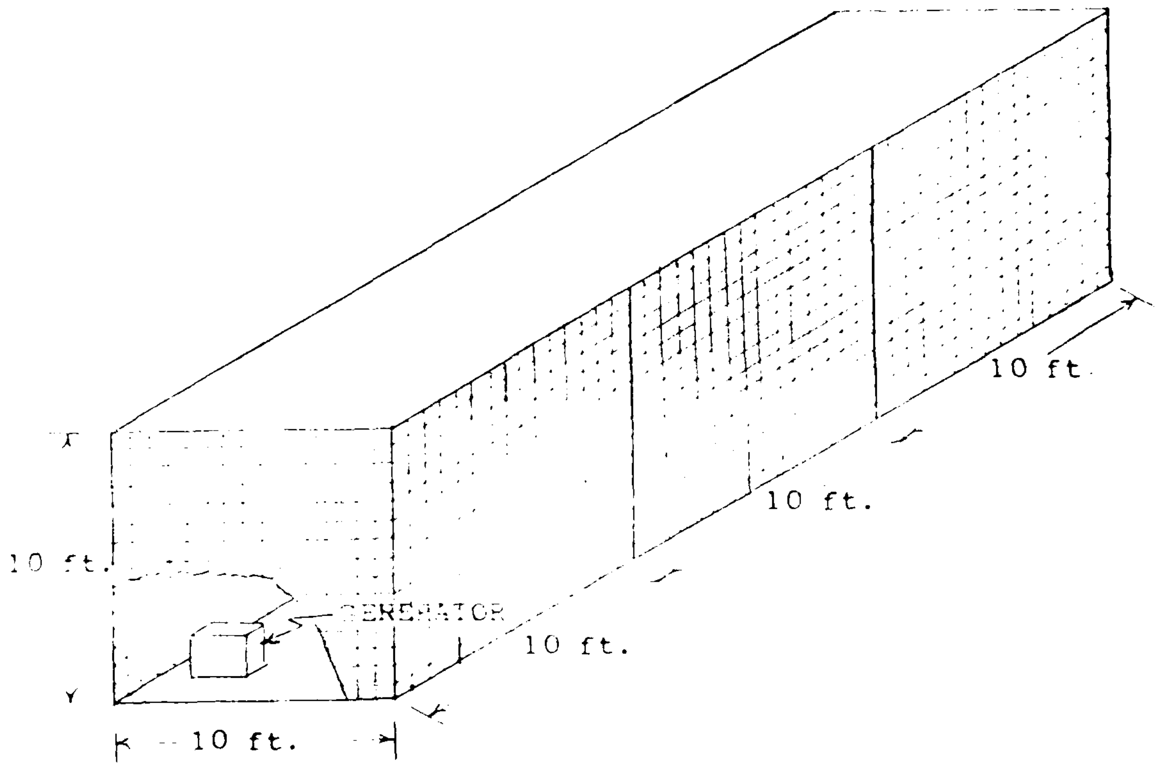


Figure 3-13. <u>Portable Electrostatic Collective Protection System Conceptional Design</u>

of visual acuity and hearing from the wearing the protective masks and hoods. P agents, in addition to the above limitations, results in reduced manual dexterity by forcing personnel to wear protective gloves which degrades the normal functioning of C^3, airfields, lines of communications (LOCs), transportation, amphibious operations, and other operations. The use of P chemical agents usually creates the need for decontamination

operations that may require the use of specialized unit personnel and equipment, and possibly NBC unit assets. Nuclear contamination (fallout) delays or denies the use of facilities and terrain and hinders individual proficiency based on the requirement for radiation exposure control to avoid the individual's becoming a casualty. Biological contamination results in similar individual and unit limitations.

NBC contamination inhibits or reduces, but does not prevent, freedom and speed of maneuver for a well-prepared commander. However, the commander, in addition to assessing his capability to support decontamination operations, must be particularly aware of time from the aspect of the following factors:

- The decreasing efficiency of his force in MOPP with increasing time (for both offensive and defensive operations).
- The time required to decontaminate and return some, or all, of his force to greater effectiveness.
- The arrival time of threat forces as a function of spacing and speed.

Due to the adverse effects of NBC contamination, doctrinal emphasis is given to bypassing contaminated areas and fighting in an uncontaminated environment. Thus, contamination avoidance is a primary NBCD measure. When a unit becomes contaminated, either due to a direct attack or by crossing contaminated areas, additional NBCD measures are taken. These actions may include increased individual protection, utilization of CP, the conduct of decontamination operations, and continued emphasis in avoiding contamination where possible. These measures limit casualties. The avoidance, protection, and decontamination sequence may be repeated throughout the entire period of a conflict.

The basic NBCD considerations related to NBC effects (the foundation of Marine Corps NBCD doctrine), based on the above, are summarized as follows:

- Readiness for unit and individual environmental survival. All FMF units must be prepared to STO in an NBC environment. This includes the use of CPE at various levels of command and combat.
- Chemical and biological. If there is an imminent threat of enemy employment of chemical or biological weapons, commanders will direct subordinate units to assume an MOPP. All enemy artillery and air attacks will be considered probable chemical attacks until proven otherwise. This doctrine is predicated on the necessity for the adoption of a defensive posture to provide protection against chemical threat. It requires personnel to be dressed in chemical protective clothing and masks before a chemical attack occurs. It also requires that CPE be utilized for prolonged periods in a contaminated environment.
- Nuclear. If there is an imminent threat of enemy employment of nuclear weapons, commanders will consider the possibility of fallout of radioactive material in addition to the initial nuclear effects, and will direct subordinate units to take appropriate defensive actions.

3.5.2 Identification of CP requirements.

The identification of MAGTF CP requirements is based on a pragmatic assessment of NBCD doctrine and concept of operations proposed in the Concept of Operations study and on applicable, current and proposed doctrine

of other Services. The experiential analysis for the basis of these requirements is contained in paragraph 3.1.4.

The requirement for CP is also based on the threat's doctrine of CW employment as a means of producing mass casualties and obstacles to normal operations and timely mission accomplishment. The possible mix of agent persistency and contamination, by CW attack, based on battlefield location, is shown in figure 3-14, with the degree of CP superimposed the right side of the figure.

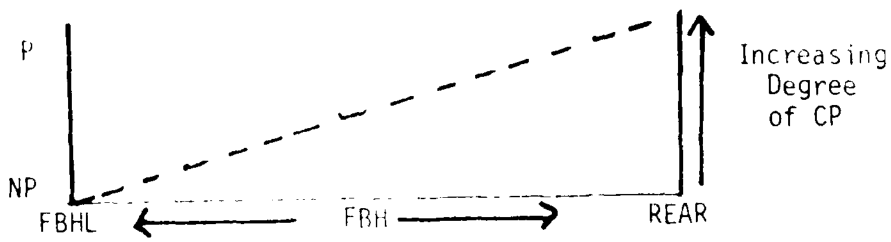


Figure 3-14. Possible Contamination Based on Battlefield Location

The problem of CP for a MAGTF in a contaminated environment was considered in view of generalized mission requirements in this study as well as those postulated by NATO allies and Israeli forces. The latter was determined first hand by a visit in June-July 1980 to seven Allied Nations during the Concept of Operations study. Essentially, Allied needs are similar

to those of the Marine Corps in that the CPE must meet the following criteria:

- Lightweight
- Reasonably rugged for field applications
- Small cubage when stored (especially aboard ship)
- Easily assembled, disassembled, and transported
- Require no additional manpower
- Easily maintained
- Adaptable to various functions such as C^3, rest and relief, and so forth.

However, the CPE for a MAGTF must also be amenable to the following special requirements of amphibious operations:

- Erectable on the beach with minimum superstructure
- Not adversely affected by salt water
- Erectable within available buildings, culverts, and so forth
- Durable

In addition, possible contamination patterns discussed in annex 2, and the combat assessment technique (CAT) results from the wargaming were analyzed and provided representative contamination patterns which would affect MAGTF operations in contaminated environments. The contamination patterns dictated certain generalized CP requirements which were evaluated against the possible threat, mission requirements, and Marine Corps doctrine and Concept of Operations for NBCD and the specific results are delineated in paragraph 3.6. However, generalizations from these results can be listed as follows:

- Armored and fighting vehicles will provide respiratory protection for Marines against NBC hazards. C^3 systems, medical

facilities, maintenance, supply, and wing units must be provided CP systems in order to provide clean work areas, personnel relief, and protection for specialized equipment and tasks.

- Units along the FBHL must be capable of eating, drinking, resting, and taking care of bodily functions while operating in a contaminated environment. If the unit is contaminated, it must be rotated out of the FBH within the life cycle of the protective ensemble to an uncontaminated area or, if in a contaminated area, to a changing facility in which to change their protective ensemble and take care of other bodily functions. Wherever possible, existing shelters for medical, supply, and maintenance units should be equipped with kits which permit rapid retrofitting of filtered air pumps/hoses, necessary seals, and contamination control areas for entrances/exits.

3.5.3 Combat units.

Combat units, engaged in the assault within the FBHL, will require a minimum of CPE. Because of their proximity to enemy units they will normally be attacked by [illegible] which will present a short duration hazard. Additionally, [illegible] these units, to close with and destroy the enemy, requires a high degree of mobility which precludes the use of most CP systems [illegible] limited storage space and limited transportation [illegible] reduce the availability of CPE. Offensive combat operations [illegible] the use of CP since units cannot pause to occupy a CP shelter [illegible] and relief are to be accomplished in a contaminated environment [illegible] withdrawn from offensive

combat operations. In considering contamination duration of NP from the Dugway report, the data reveals that the need for CPE is not critical. The report shows that combat units can operate in prescribed levels of MOPP until the degree of contamination drops below a militarily significant level or they are able to move through the contamination without sustaining a significant amount of casualties.

If combat units cannot move through or around the contamination and the contamination level is maintained through repeated CW strikes, then the combat units at risk must have the capability of providing limited CP. The primary purpose of CP for combat units is to provide places for rest and relief during defensive or static situations in contaminated areas.

The only CPE developmental system that presently appears feasible for combat units to use is SCPE. The CP system should be authorized at battalion level, where enough SCPE units would be held to provide one per company. The battalion NBC section would issue the SCPE to companies or consolidate all the assets in the battalion area, depending on when and where the protection is needed. This would provide the battalion commander with the flexibility to establish CP when and where he desires based upon the dictates of the tactical situation.

3.5.4 Combat support units.

Combat support units could be attacked with either NP or P agents depending upon their location and/or mission. Units close to the FBHL, such as armor and assault amphibians, will normally be subject to NP attacks for the same reasons mentioned for combat units. Other units such as artillery, armor/assault amphibian units in reserve, and units utilizing communication or radar shelters/vans, would be more likely to be attacked with P agents.

There is a requirement that some form of CPE be made available to all combat support units. In particular, communications and radar vans/shelters, in which personnel must operate in a shirt-sleeve environment, must have an MCPE system. The shelter for the TACFIRE is an example of MCPE currently being developed. The 200, 400, and 600 cubic feet per minute (CFM) MCPEs should be considered for current S-250/S-280 shelter modifications to provide them with CP capability. Some sections of combat support units such as the fire direction center (FDC), which are not vehicle mounted, may utilize the SCPE. Combat support units also require SCPE for rest and relief as discussed in paragraph 3.5.2.

The CPE requirements for SP howitzers are shown in table 3-5, page 3-28, while CPE for armored vehicles was previously described in paragraph 3.2.5. The hybrid system being developed must be incorporated into the new USMC combat vehicle design programs. It is extremely important that this CPE system be included in future amphibious assault and lightweight combat vehicles being exclusively developed by the Marine Corps.

3.5.6 Combat service support units.

Combat service support units are usually located closer to each other in the FBH than is desirable for tactical dispersion. The beach areas will present a high density target ideal for P agents. Combat service support units will [illegible] for maintenance operations, rest and relief as well as [illegible] since they have limited [illegible] allow relocation out of contaminated areas.

[illegible] perform their vital mission, these units [illegible] operations in a toxic environment.

While many of the support functions can be done by personnel wearing the NBC protective ensemble, the nature of some of these jobs will soon cause fatigue and heat stress (weather dependent) among these Marines. In the early stages of the buildup ashore, support functions will be conducted "around the clock" and, therefore, contamination-free environment provided by some form of CP is critical. Rotation of personnel through CP shelters to allow for rest, relief and feeding may become a routing matter for sustained operations in a contaminated area. Sufficient CP must be made available to accommodate this requirement.

Initially, units may have to rely on the smaller CP shelters like the M6/M6A1 units. As the buildup progresses, maximum use must be made of existing structures to provide larger CP shelters of the type discussed in paragraphs 3.2.2 through 3.2.3. These will require the use of GPFU and air locks as well as a means of sealing large air leaks. The current M6/M6A1 can be used for this purpose; however, they are very limited in their capability. The SCPE mentioned in paragraph 3.4.5 appears to best suit the needs of the combat service support units where existing structures can be converted into shelters.

Within the FSSG units, there are several functions that must be done in a shirt-sleeve environment. In most cases, these functions are performed in a mobile shelter or vehicle mounted van/shelter. These shelters can be modified to provide a contamination-free working environment by the addition of MCPE units. Examples of these types shelters are:

Electronics maintenance company, maintenance battalion, FSSG

- Shelter, electronics [illegible]
- Shop, electronic AN/[illegible]

General support maintenance company, maintenance battalion, FSSG:

- Missile maintenance shop AN/GSM-216
- Van, maintenance, DRAGON weapon system
- Van, maintenance, TOW weapon system

3.5.6 Special requirements.

Wing/squadron operations ashore will require CPE for sustained operations in a contaminated environment. Both SCPE and MCPE will be required as well as modification of existing structures, when available, for protection against a CB atmosphere. There is no doubt that air operations will be the target of P agents according to Soviet/WP CB employment and, therefore, an efficient CP system will be required to protect both aviators and crewman from any degree of contamination or CW agent effects. The same criteria will apply to combat service support functions which will take place within the FSSG area. At present, it appears that modifications to the small shelters in MCESS could meet immediate requirements for CP for these types of units.

The MCESS described in paragraph 3.3.2 and shown in table 3-8 appears to have some shelters which could be modified into CP shelters by the addition of a positive pressure entrance and a filter/blower system for a clean, positive pressure environment. These shelters are the following:

- 8 foot by 8 foot by 20 foot, knockdown
- 8 foot by 8 foot by 20 foot, rigid
- 8 foot by [illegible], EMI
- 8 foot by [illegible] foot, EMI

The remaining shelters in table [illegible] not designed to accommodate the addition of CP to [illegible] environment. However, the shelters that [illegible] need to be tested to

ensure that they could be modified into CP shelters and then evaluated as to how many would be required based upon:

- criticality of operational use
- cost
- handling and storage requirements

MCDEC has been tasked by HQMC to "develop integrated CB protection kits for small MCESS shelters."[1] Upon completion of this task the elements of the FSSG and wing will have an enhanced CP capability which will overcome many of the previously noted deficiencies. Since this action is ongoing, the study can make only generalized recommendations with regard to CPE for the MCESS items.

These recommendations are based upon the guidance set forth by the MCESS working group[2] and are shown in tables 3-11 and 3-12. Table 3-11 shows the quantities of MCESS recommended by the working group and the generalized CPE recommendations proposed by the study team. Table 3-12 further defines the CPE recommendations by displaying them by specific systems or by functional use.

There are major systems, currently in use, which are contained in shelters and vans that will not be replaced by MCESS. These critical systems must be modified to utilize CPE.

Some of the current systems which should be investigated as to utilization of CPE are shown in table 3-13.

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[1]Total Marine Corps RDT&E work directive NR/title C0081-X, Marine Corps Expeditionary Shelter System (MCESS), 8 October 1981.

[2]MCESS Working Group, Final Report, Northrop Services, Incorporated, Arlington, Virginia, 31 August 1981.

Table 3-11. MCESS Quantity and CPE Recommendations

ORGANIZATION	MCESS Recommended (1)				MCESS CPE Proposed			
	10E	20E	20R	20K	10E	20E	20R	20K
FMF								
H&S Bn, FMF (2)		3	1			3	1	
CAG								
Force Recon Co.								
ANGLICO		2				2		
Radio Bn	3	[illegible]			3	4		
Comm Bn, Hq Co.		8	5	8		7		
Comm Co.		2	1	7		2	1	
LL Co.								
Comm Sup Co.		3	7		3			
Division								
Infantry Regt. Hq, Co.								
Infantry Bn, H&S Co.								
Infantry Wpns Co.								
Rifle Co.								
Artillery Regt Hq Btry		3				3		
Artillery Bn, Hq Btry			3*	1			1*	
Artillery Btry, 105			9*				1*	
Artillery Btry, 155T			12*				1*	
Artillery Btry, 155SP			2*				1*	
Artillery Btry, 175								
Artillery Btry 8 in			3*				1*	
Recon Bn, H&S Co.								
Recon Co.								
Tank Bn, H&S Co.								
AT Co								
Tank Co.								
ASLT Amphib Bn, H&S Co				1				
ASLT Amphib Co.								
CBT Engr Bn H&S Co.								
Engr Spt Co.								
CBT Engr Co.								
Hq Bn, Div, Hq Co.								
SVC Co.			8	[illegible]			7	
Truck Co.								
MP Co.								
Comm Co.				[illegible]		7	2	4
H&S Co. MAF								
Spt COMSECTM	[illegible]				1			
MAB Contingency				[illegible]			3	1
MT Co. BSSG				8				
MAINT Co. 1st BSSG				[illegible]				2

NOTE:
(1) [illegible]
(2) FMFLANT [illegible]
* [illegible]

Table 3-11. MCESS Quantity and CPE Recommendations (Continued)

ORGANIZATION	MCESS Recommended(1)				MCESS CPE Proposed			
	10E	20E	20R	20K	10E	20E	20R	20K
FSSG H&S Bn, H&S Co.		3	22	4		3	12	
Comm Co				1				
MP Co								
Svc Co			9				9	
Ldg Spt Bn, H&S Co.				1				1
B&P Opns Co.								
Ldg Spt Co.								
Sup Bn, H&S Co.			3	4			3	
Med Log Co			18	3			3	
Sup Co.								
Ration Co								
Ammo Co			4	7			4	
Maint Bn, H&S Co.			24					
Ord Maint Co.			19				4	
MT Co.			41	6			14	
Engr Maint Co.			4					
Elect Maint Co.		16				16		
G/S Maint Co.		18	39	7			3	
Engr Spt Bn, H&S Co.								
Support Co			3					
Bridge Co.								
Bulk Fuel Co.								
MT Bn, H&S Co.			3					
Truck Co.								
Transport Co								
Marg Ter Veh Co.								
Med Bn, H&S Co.								
Hosp Co.								
Dental Bn, H&S Co.								
Dental Co.								

NOTE:
(1) Recommended by MCESS Working Group
(2) FMFLANT
* Programmed for S-280 Shelter

Table 3-11. MCESS Quantity and CPE Recommendations (Continued)

ORGANIZATION	MCESS Recommended(1)				MCESS CPE Proposed			
	10E	20E	20R	20K	10E	20E	20R	20K
Wing MWHS		2				2		
MACG H&HS								
MWCS		20	13	26		16	5	
MACS		22	14	20		10	6	
MASS		6	3	5		6		
MATCS								
FAAD Btry								
LAAM Bn, H&S Co.		7	1			5		
LAAM Btry								
VMGR								
VMAQ								
VMFP			5				5	
MAG VF/VA H&MS								
MABS		6	18	12		2	6	
VMA/AV8								
VMA/A4								
VMFA/F4								
MAG VH H&MS								
MABS		4	8	6		2	6	
VMO								
HML								
HMA								
HMM								
HMH								
MWSG HQ Sqdn		1	3	8		1		
WES			3	2				
WTS			16					

NOTE:
(1) Recommended by MCESS Working Group
(2) FMFLANT
* Programmed for S-280 Shelter

Table 3-12. MCESS CPE Requirements by System and Function

ORGANIZATION	AN/ GRM-86	FDC	AN/ GRM 32	AN/ GRM 38	C/E Maint	COM Opns	Admin	Maint	Log	AN/ GRM 82	AN/ TYQ 19	AN/ PAQ 3	AN/ TYQ 12	AN/ GRM 99	512n	Asst Opns
FMF																
H&S Bn, FMF (LANT)											3B					
CAG											1C					
Force Recon Co.																
ANGLICO		1B						1B								
Radio Bn								3A		2B					[illegible]	
Comm Bn, Hq Co.		2B	2B	1B											2B	
Comm Co.						2B,1C										
TT Co																
Comm Sup Co.						3B										
Division																
Infantry Regt, Hq, Co.																
Infantry Bn, H&S Co.																
Infantry Wpns Co.																
Rifle Co.																
Artillery Regt Hq Btry	3B															
Artillery Bn, Hq Btry		1C														
Artillery Btry, 105		1C														
Artillery Btry, 155T		1C														
Artillery Btry, 155SP		1C														
Artillery Btry, 175																
Artillery Btry 8 in.		1C														
Recon Bn, H&S Co.																
Recon Co.																
Tank Bn, H&S Co.																
AT Co.																
Tank Co.																
Aslt Amphib Bn, H&S Co.																
Aslt Amphib Co.																
Cbt Engr Bn H&S Co.																
Engr Spt Co.																
CBT Engr Co.																
Hq [illegible], Div, Hq Co.																
Svc Co.							7C									
Truck Co.																
[illegible]																
Comm Co	2B		1B	1B	1B,2C, 4D									2B		
Spt COMSEC TM						1A										
MAF Contingency										3B,1C						
[illegible] Co. 1st FSSG											2C					
H&S Co MAF																

NOTE:

A - MCESS 8 foot by 8 foot by 10 foot shelter, EMI (E)
B - MCESS 8 foot by 8 foot by 20 foot shelter, EMI (E)
C - MCESS 8 foot by 8 foot by 20 foot shelter, Rigid (R)
D - MCESS 8 foot by 8 foot by 20 foot shelter, Knockdown (K)

Table 3-12. MCESS CPE Requirements by System and Function (Continued)

ORGANIZATION	AN/ GRM-86	FDC	AN/ GRM 32	AN/ GRM 38	C/E Maint	COM Opns	Admin	Maint	Log	AN/ GRM 82	AN/ TYQ 19	AN/ PAQ 3	AN/ TYQ 12	AN/ GRM 98	5126	Asst Opns
Wing																
MWHS													2B			
MACG																
H&HS																
MWCS	8B		2B	2B		1B,5C								1B	2B	
MACS	7B				2B			6C						1B		
MASS	1B				4B									1B		
MATCS																
FAAD Btry																
LAAM Bn, H&S Co.	5B															
LAAM Btry	1B															
VMGR																
VMAQ																
VMFP								5C								
MAG VF/VA																
H&MS																
MABS						2B		2C	4C						1B	
VMA/AV8																
VMA/A4																
VMFA/F4																
MAG VH																
H&MS																
MABS						1B		2C	4C						1B	
VMO																
HML																
HMA																
HMM																
HMH																
MWSG																
HQ Sqdn															1B	
WES																
WTS																

NOTE:
A - MCESS 8 foot by 8 foot by 10 foot shelter, EMI (E)
B - MCESS 8 foot by 8 foot by 20 foot shelter, EMI (E)
C - MCESS 8 foot by 8 foot by 20 foot shelter, Rigid (R)
D - MCESS 8 foot by 8 foot by 20 foot shelter, Knockdown (K)

Table 3-12. MCESS CPE Requirements by System and Function (Continued)

ORGANIZATION	AN/ GRM-86	FDC	AN/ GRM 32	AN/ GRM 38	C/E Maint	COM Opns	Admin	Maint	Log	AN/ GRM 82	AN/ TYQ 19	AN/ PAQ 3	AN/ TYQ 12	AN/ GRM 98	5126	Asst Opns
FSSG																
H&S Bn, H&S Co.									12C		3B					
Comm Co																
MP Co																
Svc Co									9C							
Ldg Spt Bn, H&S Co.					1D											
B&P Opns Co.																
Ldg Spt Co.																
Sup Bn, H&S Co.									3C							
Med Log Co								3C								
Sup Co.																
Ration Co																
Ammo Co																4C
Maint Bn, H&S Co.																
Ord Maint Co.								4C								
MT Co.								14C								
Engr Maint Co.																
Elect Maint Co.	8B		4B	4B												
G/S Maint Co.	4B				14B			8C								
Engr Spt Bn, H&S Co.																
Support Co.																
Bridge Co.																
Bulk Fuel Co.																
MT Bn, H&S Co.																
Truck Co.																
Transport Co																
Marg Ter Veh Co.																
Med Bn, H&S Co.																
Hosp Co.																
Dental Bn, H&S Co.																
Dental Co.																

NOTE:

A - MCESS 8 foot by 8 foot by 10 foot shelter, EMI (E)
B - MCESS 8 foot by 8 foot by 20 foot shelter, EMI (E)
C - MCESS 8 foot by 8 foot by 20 foot shelter, Rigid (R)
D - MCESS 8 foot by 8 foot by 20 foot shelter, Knockdown (K)

Table 3-13. Current Systems Requiring CPE

TAM No.	Nomenclature
A0010	Airborne Mobile Direct Air Support Central, AN/UYQ-3
A0060	Air Support Radar Team Communications Facility, AN/TPA-9
A0175	Calibration Complex, Transportable, AN/TSM-119 (2 shelters-each)
A0177	Calibration Shop, Transportable, AN/TSM-124
A0240	Central Office Telephone, AN/MTC-1 (2 shelters-each)
A0246	Central Office Telephone, Automatic, AN/TTC-38(V) 1 (2 shelters-each)
A0268	Communication Central, AN/TGC-37
A0270	Communication Central, AN/TSC-15
A0860	Intercept Control Facility, AN/TSQ-54A
A1460	Radar Set, AN/TPS-22D (2 shelters-each)
A1470	Radar Set, AN/TPS-32 (1 shelter) (2 shelters-each)
A1500	Radar Set, AN/TPS-63
A2310	Shelter, Electrical Equipment, S-126 A/G
A2320	Shelter, Electronics Maintenance Support, AN/GRM-86

Table 3-13. Current Systems Requiring CPE (Continued)

TAM No.	Nomenclature
A2355	Shop Electronic, AN/GRM-32D
A2355	Shop, Electronic, AN/GRM-38B
A2357	Shop, Electronic, AN/GRM-82
A2362	Shop, Electronic Maintenance, AN/GRM-98
A2440	Communications Central, AN/MSC-43 (Shelter)
A2530	Tac Air Op Central AN/TYQ-2 (1 shelter) (8 shelters-each) (5 shelters-each) (2 shelters-each)
A2540	Tactical Data Communications Central, AN/TYQ-3 (1 shelter) (2 shelters-each) (1 shelter)
A2695	Test Equipment Facility, AN/GRM-104 (2 shelters-each)
A0823	Imagery Interpretation Facility, AN/TSQ-82
B1312	Mapping Set, Topographic Trailer Mounted (2 shelters each expanded)
B1455	Photographic System Combat--Non Aerial (4 shelters-each)
B1755	Reproduction Equipment Set, Topographic, Trailer, Mounted (4 shelters-each)
D0320	Shop Set, Automotive, Fuel and Electrical (1-M109A3 Van-Shelter)

Table 3-13. Current Systems Requiring CPE (Continued)

TAM No.	Nomenclature
D0330	Shop Set, Automotive, Fuel and Electrical (1-M109A3 Van-Shelter)
E0561	Guided Missile Battery Control Central, AN/TSW-8
E0697	Improved Platoon Command Post
E0700	Information Coordination Central, HAWK Trailer Mounted
E1038	Missile Maintenance Shop, AN/GSM-216 (REDEYE)
E1160	Operations Central, AN/TSQ-39
NAVY-FUNDED SHELTERS	
Q0900	Radar Set, AN/TSQ-107
Q0908	Radio Set, AN/TRN-29, TACAN
Q0920	Air Traffic Control Tower, AN/TSA-28A (1 shelter) (1 shelter)
Q0930	Radar, Approach, Control Central, AN/TSQ-18A (2 shelters-each) (1 shelter)

It is recommended that two items of equipment, which are standard issue in the U.S. Army, be considered as interim measures until improved systems for NBC patient use are developed and fielded. The M14, gas-particulate filter units (GPFU), 6-man ventilated facepiece, 12 CFM, NSN4240-00-010-5267, which is used in the Army armored ambulance, should be considered for installation in 25 percent of LVTP7s per assault amphibian company to provide patient protection during evacuation. The medical department also should consider using the M7A1 GPFU, hospital, 6-patient ventilated facepiece, 12 CFM, NSN4240-00-203-3999, in medical and hospital companies. Additional discussion and specific special requirements for the handling of casualties within the FBH are addressed in chapter 4 of this report.

3.5.7 MAGTF collective protection. The type of protection recommended for a MAGTF, based on the preceding rationale, is summarized in table 3-14.

3.6 RECOMMENDED CPE FOR THE MAGTF

3.6.1 Selection of CPE.

The study team's selection of CPE was the culmination of extensive research which considered, among other things, the following:

- Decontamination systems
- Threat CW capabilities
- CAT contamination predictions over time CW agent persistencies
- CW experiential analysis
- U.S. and foreign CPE

A CP system must be backed up by some decontamination system in order to meet the requirement of a "shirt-sleeve" environment for selected functions. Therefore, the decontamination system discussed in chapter 2

Table 3-14. MAGTF Types of Protection

	MAGTF Elements				
MAGTF Collective Protection System	Combat units less vehicles	Combat support units	Combat vehicles	Combat service support	Air operations ashore
CP Requirements	Limited rest and relief.	Selected operations. Rest and relief.	Crew operations	Extensive rest and relief. Selected operations	Sustained base operations. Extensive rest and relief.
Type of CP	Small shelters	Small shelters	Ventilated facepiece. Overpressure.	Positive pressure. Shelters. Vans.	Positive pressure. Shelters. Vans.
Currently Authorized	None	M6A1 (selected units)	M8A3 (one per M48TK, M88, and M578) M13A1 (one per M60, M1, and LVTP7)	None	None
Recommended CPE (Current)	None	None	M14	M7A1	None
Recommended CPE (Developmental)	SCPE	SCPE	Hybrid	MCPE[1]. SCPE. MCESS MCECMS	SCPE. MCESS modification. MCPE[1]
Recommended CPE (Conceptual)	None	None	None	PECPS	PECPS
R and D Requirements	Shelter monitor/ detector.	Shelter monitor/ detector	Individual CB protection suit.	Shelter monitor/ detector.	Shelter monitor/ detector.
Personnel Requirements[2]	No additional personnel				

[1]MCPE for appropriate vans/shelters.
[2]Personnel will require additional limited training, of unit NBCD teams/personnel.

formed the basis for selecting CPE because [illegible] considerations.

3.6.2 Recommended CPE. The specific items of CPE which are required to implement the CP system for the MAGTF, which has been described in the preceding paragraph, and summarized on table 3-14 are listed on table 3-15.

3.6.3 Cost implications. The current 1982 figures for the recommended developmental CPE are shown in table 3-16.

3.6.4 Personnel requirements. There are no requirements for additional personnel to support the proposed CPE system. The unit NBC specialist will be the focal point for the coordination of CPE operations. Personnel from sections using CPE should be assigned NBC (CPE operations and maintenance) responsibilities as an additional duty.

3.6.5 Training. The proposed collective protection system for the MAGTF requires increased training of personnel assigned to NBCD as additional duty. The unit's NBC specialist should be trained at the US Army Chemical School in CPE operation and maintenance. Each section of the organization using the CPE systems must have necessary personnel trained, at a command NBC school, to erect, operate and service the CPE systems assigned. All personnel must be trained, through integrated exercises, in the operation of, and entry and exit procedures to ensure CPE protective capabilities are achieved.

3.6.6 Medical requirements for CPE. Special requirements for the handling of casualties within the FBH are addressed in chapter 4 of this report.

Table 3-15. Recommended CPE for the MAGTF

ORGANIZATION	TYPE OF CPE								
	Current						Developmental		
	M6A1	M7A1	M8A3	M13A1	M14	M51	SCPE	MCPE	Hybrid
FMF									
H&S Bn, FMF	1								
CAG									
Force Recon Co.									
ANGLICO								(4)	
Radio Bn							2	(4)	
Comm Bn, Hq Co.							2	(4)	
Comm Co.								(4)	
LL Co.									
Comm Sup Co.								(4)	
Division									
Infantry Regt, Hq, Co.	1						2		
Infantry Bn, H&S Co.							6		
Infantry Wpns Co.									
Rifle Co.									
Artillery Regt Hq Btry	2						2	(4)	
Artillery Bn, Hq Btry							2	(4)	
Artillery Btry, 105							1	(4)	
Artillery Btry, 155T							1	(4)	
Artillery Btry, 155SP							1	(4)	
Artillery Btry, 175							1		
Artillery Btry 8 in							1	(4)	
Recon Bn, H&S Co.									
Recon Co.									
Tank Bn, H&S Co.			(1)	(2)			4		(5)
AT Co.									
Tank Co.			(1)	(2)					(5)
ASLT Amphib Bn, H&S Co.				(2)	(3)		4		(5)
ASLT Amphib Co.				(2)	(3)				(5)
CBT Engr Bn H&S Co.							[illegible]		
Engr Spt Co.									
CBT Engr Co.									
Hq Bn, Div, Hq Co.							10	(4)	
SVC Co.									
Truck Co.									
MP Co.									
Comm Co								(4)	

NOTE.
- (1) Allocation 1 per M48 tank, 2 per M88/M578 recovery vehicle
- (2) Allocation 1 per tank, assault amphibian, or self-propelled art[illegible]
- (3) Allocation per a selected number of assault amphibians in each company
- (4) Detailed MCPE requirements delineated in tables [illegible] through [illegible]
- (5) Replacement for M8A3 and M13A1 when available.
- (6) Allocation per medical battalion to be determined

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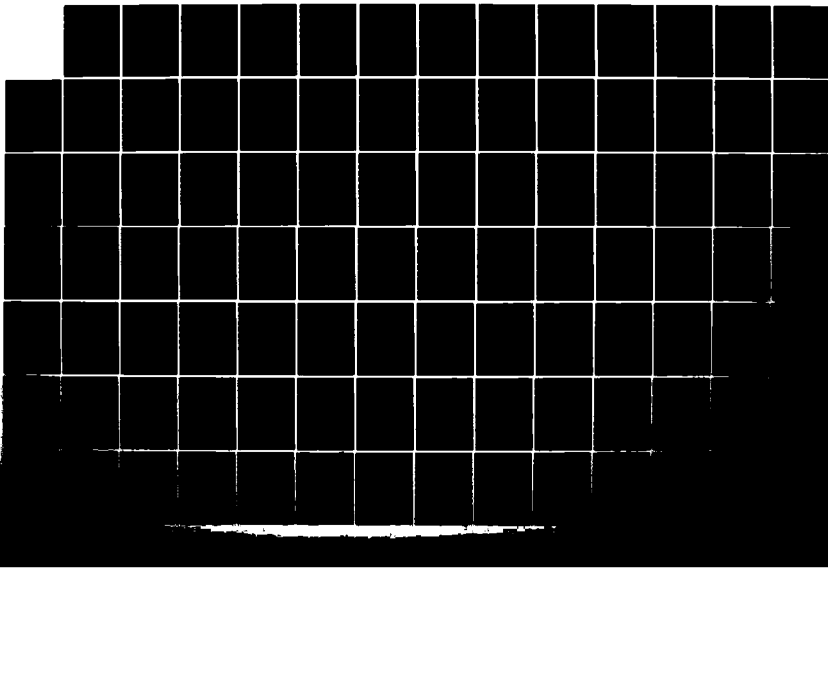

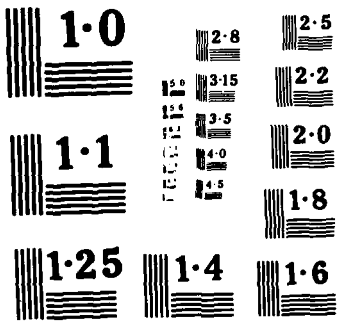

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Table 3-15. Recommended CPE for the MAGTF (Continued)

ORGANIZATION	TYPE OF CPE								
	Current						Developmental		
	M6A1	M7A1	M8A3	M13A1	M14	M51	SCPE	MCPE	Hybrid
<u>FSSG</u>									
H&S Bn, H&S Co.	2						10	(4)	
Comm Co									
MP Co									
Svc Co								(4)	
Ldg Spt Bn, H&S Co.							5		
B&P Opns Co.								(4)	
Ldg Spt Co.									
Sup Bn, H&S Co.	2						10	(4)	
Med Log Co								(4)	
Sup Co.									
Ration Co									
Ammo Co								(4)	
Maint Bn, H&S Co.	2						14		
Ord Maint Co.								(4)	
MT Co.								(4)	
Engr Maint Co.									
Elect Maint Co.								(4)	
G/S Maint Co.	25							(4)	
Engr Spt Bn, H&S Co.	2						8		
Support Co									
Bridge Co.									
Bulk Fuel Co.									
MT Bn, H&S Co.	1						8		
Truck Co.									
Transport Co									
Marg Ter Veh Co.									
Med Bn, H&S Co.		(6)					4		
Hosp Co.									
Dental Bn, H&S Co.							2		
Dental Co.									

NOTE:

(1) Allocation 1 per M48 tank, 2 per M88/M578 recovery vehicle.
(2) Allocation 1 per tank, assault amphibian, or self-propelled artillery.
(3) Allocation per a selected number of assault amphibians in each company.
(4) Detailed MCPE requirements delineated in tables 2-10 through 2-12
(5) Replacement for M8A3 and M13A1 when available.
(6) Allocation per medical battalion to be determined.

Table 3-15. Recommended CPE for the MAGTF (Continued)

ORGANIZATION	TYPE OF CPE								
	Current						Developmental		
	M6A1	M7A1	M8A3	M13A1	M14	M51	SCPE	MCPE	Hybrid
Wing									
MWHS	4						10	(4)	
MACG									
H&HS	2						2		
MWCS	2						2	(4)	
MACS	2						2	(4)	
MASS	2						2	(4)	
MATCS							2		
FAAD Btry									
LAAM Bn, H&S Co.	4						2	(4)	
LAAM Btry								(4)	
VMGR	2						2		
VMAQ	4						2		
VMFP	4						2	(4)	
MAG VF/VA									
H&MS	2								
MABS	2						2	(4)	
VMA/AV8	2						6		
VMA/A4	2						2		
VMFA/F4	2						2		
MAG VH									
H&MS	2						2		
MABS	2						6	(4)	
VMO	1						2		
HML	2						2		
HMA	2						2		
HMM	2						2		
HMH	2						2		
MWSG									
HQ Sqdn	2						2		
WES	25						2	(4)	
WTS	2						2		

NOTE:

(1) Allocation 1 per M48 tank, 2 per M88/M578 recovery vehicle.
(2) Allocation 1 per tank, assault amphibian, or self-propelled artillery.
(3) Allocation per a selected number of assault amphibians in each company.
(4) Detailed MCPE requirements delineated in tables 2-10 through 2-12 .
(5) Replacement for M8A3 and M13A1 when available.
(6) Allocation per medical battalion to be determined.

Table 3-16. Developmental CPE Costs in 1982 Dollars

CP Equipment	Cost
MCPE for TACFIRE (200 CFM)	$10,400
MCPE for AN/TSQ73 (600 CFM)	$12,400
NBC hybrid CPE for combat vehicle	$ 7,500 (including installation, labor)
SCPE, XM 20	$ 5,959
MCPE, 200 CFM, M56	$10,400
MCPE, 400 CFM, M59	$11,400
MCPE, 600 CFM, M61	$12,400

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 4

NBC CASUALTY HANDLING IN THE MAGTF

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 4. NBC CASUALTY HANDLING IN THE MAGTF

4.1 INTRODUCTION

The prospect of conducting operations on the integrat 1 battlefield presents the medical department with, perhaps, its most severe challenge. Without proper equipment, organization and training, it may prove impossible for the medical department to fulfill its stated mission.

> "The mission of the medical department in the combat theater is to return patients to duty with the fleet Marine force (FMF) and the fleet in-theater, if possible, and to stabilize and prepare for evacuation those patients whose length of stay is expected to exceed the evacuation policy."

The threat of mass casualties produced by the introduction of nuclear weapons to the battlefield has been recognized for some time and much has been written on this subject. However, little guidance has been provided on the problem of chemical and biological (CB) agent casualties. While the initial use of CB agents against unprepared troops may cause a mass casualty situation, these weapons will produce a manageable level of patients if proper nuclear, biological, and chemical defense (NBCD) equipment and training have been instituted in the FMF. The Marine air ground task force (MAGTF) must be aware of the potential threat and take proper defensive precautions during planning and execution in order to hold casualties to an acceptable level.

A MAGTF conducting an opposed amphibious assault may experience, and must plan and prepare, for extremely heavy casualties occurring among the assault waves, or within a day or two of the landing. The number of casualties

depending heavily on the degree of tactical surprise achieved and on the combat capability and doctrine of the defending force. These casualties place the greatest strain on the medical system during a period of transition from ship to shore. The medical support system must display great flexibility and responsiveness during this critical transition period.

As an historical example, the one-division landing at Tarawa in World War II experienced very heavy casualties among the initial assault waves before they even made it ashore. By 36 hours after H-hour, two assault regiments had lost about 35 percent of their table of organization (T/O) strength and could muster only one combat effective battalion between them. Because of this high initial casualty rate, and the limited medical support available, the casualty treatment ratio (the ratio of WIA to KIA) was the lowest for Tarawa (2.3) of any comparable assaults. By contrast, the similar-sized assault at Peliliu had greater overall casualties, but fewer occurred on D-day, and the treatment ratio for D-day was a relatively high 4.3. The 1st Marines at Peliliu took approximately 20 percent casualties on D-day and were able to continue in combat for the remainder of the week-long battle. By the end of the week, however, they had suffered more than 1,700 casualties and were of limited combat effectiveness.

With these historical examples as illustrations, we may suggest certain design criteria for medical support of amphibious assaults. The medical system should be designed to handle:

- The maximum sustainable casualty rate for assault waves (regiment-sized units), which can run as high as 25 percent on D-day or D+1.

- The maximum sustainable casualty rate for division-sized units conducting an amphibious assault, which is 5 to 10 percent per day over a several day period.
- The patients resulting from these casualty rates with an expected casualty treatment ratio for conventional weapons that should approximate 4:1 (unconventional weapons will be discussed later).

Mass casualty situations, which may result from either conventional or NBC weapons use, are by definition not sustainable, may result in mission failure, and should not be used as design conditions for medical support.

4.2 CHEMICAL THREAT CHARACTERISTICS

The chemical agent threat presents the medical support system with its most severe problems with respect to treatment and handling of patients. The introduction of chemical agents on the battlefield places severe limitations on the ability of the Medical Department to function effectively in providing medical support. The current NBC protective ensemble hinders the function of medical personnel. Contamination of patients and equipment further delays and degrades medical attention. The management and treatment of contaminated patients presents unique medical problems. Not only is the treatment exacting in many cases, but also the patient may represent a hazard to the medical personnel. Treatment and handling must consider the safety of both the patient and those providing medical support. The medical support system must be designed to meet these requirements so that it can continue its mission on the integrated battlefield.

The medical support system in the MAGTF force beachhead (FBH) must be able to operate in a contaminated environment for various periods of time. The more forward elements of medical support will be subjected to the same level of threat as the combat unit they are supporting. Medical units in

the rear of the FBH may be able to locate initially in contamination free areas. However, they may be exposed to chemical agents drifting downwind from an attack. The medical units themselves may be the target of a chemical attack. The medical support system will be forced to take NBC protective measures for their own survival and then conduct their mission while in an NBC protected posture. To accomplish this the medical support system must be organized, equipped and trained in the fundamentals of NBCD as specified for all MAGTF units. Commanders of medical units must ensure that their units can survive and operate effectively on the integrated battlefield.

The characteristics of medical casualties under chemical warfare (CW) conditions reflect the types, capabilities, and employment of enemy weapons--both chemical and conventional. The principal types of Soviet chemical agents are estimated to be nerve agents, vesicants, and a blood agent. The nerve agents are the most toxic and tactically versatile type of agent. They are believed to be the preferred Soviet chemical agents. However, in considering medical implications of CW, it must be recognized that casualties could be sustained due to exposure to any one or more types of chemical agents. Highlighted in the following paragraphs are characteristics typical of medical workloads under CW conditions.

The general effects on man of the various types of chemical agents are summarized in table 4-1. Specific effects of these agents, identified as important for medical support, are summarized below:

- Nerve agents. The time course of nerve agent effects is shown in table 4-2. Slight exposure to nerve agents could interfere with some occupations on the battlefield, but the three degrees of

Table 4-1. General Effects of CW Agents[1]

	Nerve Agents (GA, GB, GD, VX)	Vesicants (H, HD, HN, L, HL)	Blood Agents (AC, HCN, CK)
Mechanism of action	Anticholinesterase agents producing cholinergic poisoning.	Vesicant	Systemic poison
Eyes	Miosis, redness, pain, dimness of vision, headache, lacrimation	Miosis, redness, edema, gritting pain, lacrimation photophobia, scarring	
Nose	Rhinorrhea	Swelling, irritation, ulceration, discharge, edema of larynx	
Throat	Tightness		
Respiratory tract	Tightness in chest wheezing, bronchial secretion, cough dyspnea, pulmonary edema, cyanosis	Irritation, hoarseness, aphonia, cough, tightness, dyspnea, rales, pneumonia, fever	Deep respiration, followed rapidly by dyspnea, gasping and then cessation of respiration
Skin	Sweating	Redness, burning, blisters, later necrosis	Pinker than normal
Gastrointestinal tract	Salivation, anorexia, nausea, vomiting, abdominal cramps, substernal tightness, heartburn, eructation, diarrhea, tenesmus, involuntary defecation	Pain, nausea, vomiting, diarrhea	Nausea
Cardiovascular system	Pallor, some rise in blood pressure	Shock, later depression of bone marrow. H, HL-hemolytic anemia, pulmonary edema	

Table 4-1. General Effects of CW Agents[1] (Continued)

	Nerve Agents (GA, GB, BD, VX)	Vesicants (H, HD, HN, L, HL)	Blood Agents (AC, HCN, CK)
Central nervous system	Giddiness, tension, insomnia, headache, drowsiness, poor memory, difficulty concentrating, confusion, slurred speech, ataxia, weakness, coma with areflexia, Cheyne-Strokes respiration, convulsions	Malaise, depression prostration	Giddiness, headache, coma, convulsions, later irrational behavior, ataxia
Muscles	Fasciculation, fatigue, cramps, weakness including muscles of respiration		

[1]Data extracted from NAVMED P-5041, Treatment of Chemical Casualties and Conventional Military Chemical Injuries, Department of the Navy, Washington, D.C., 30 May 1974.
UNCLASSIFIED. For additional information on CW casualty characteristics and medical treatment requirements refer to NAVMED P-5059, NATO Handbook on the Medical Aspects of NBC Defensive Operations. AMED P-6, August 1973.

Table 4-2. Time Course of Effects of Nerve Agents[1]

	Type of Effects	Route of Absorption	Description of Effects	When Effects Appear After Exposure[2]	Duration of Effects: Mild Exposure	Duration of Effects: Severe Exposure
Vapor	Local	Lungs	Rhinorrhea, nasal hyperemia, tightness in chest, *wheezing*	1 to several minutes	a few hours	1-2 days
Vapor	Local	Eyes	Miosis, conjunctivitis, hyperemia, eye pain, frontal headache	1 to several minutes	Miosis-24 hours	3-14 days 2-5 days
Vapor	Systemic	Lungs or Skin	See table 4-1	Less than 1 minute to a few minutes after moderate or marked exposures about 30 minutes after mild exposure	Several hours	8 days
Liquid	Local	Eyes	Same as vapor effects	Instantly	Similar to effects of vapor	
Liquid agent	Local	Ingestion	Gastrointestinal (see table 4-1)	About 30 minutes after ingestion	3 days	5 days
Liquid agent	Local	Skin	Local sweating and muscular twitching	3 minutes - 2 hours	3 days	5 days
Liquid agent	Systemic	Lungs	See table 4-1	Several minutes		1-5 days
Liquid agent	Systemic	Eyes	Same as vapor	Several minutes		2-4 days

Table 4-2. Time Course of Effects of Nerve Agents[1] (Continued)

	Type of Effects	Route of Absorption	Description of Effects	When Effects Appear After Exposure[2]	Duration of Effects Mild Exposure	Duration of Effects Severe Exposure
Liquid agent	Systemic	Skin	Generalized sweating	15 minutes - 2 hours		2-5 days
Liquid agent	Systemic	Ingestion	Gastrointestinal (see table 4-1)	15 minutes - 2 hours		3-5 days

[1]Data extracted from NAVMED P-5041.

[2]After lethal or near lethal exposures to nerve agents, the time to onset of symptoms and maximum severity of symptoms is shorter; it may be extremely brief after overwhelming exposure. Following exposure to lethal concentrations, the time interval to death depends on the degree, route of exposure, and the agent. For example, GB is most toxic by inhalation. GA is more toxic through the skin that GB. If inhaled, VX acts as fast as GB and is more toxic. Exposure to lethal concentration of GB results in death 5 minutes after appearance of symptoms if untreated.

incapacitation that require significant medical treatment are shown in table 4-3. Severe nerve agent exposure may rapidly cause unconsciousness, muscular paralysis, and cessation of breathing.

Table 4-3. Degrees of Incapacitation Resulting from Exposure to Nerve Gas (GB)*

Moderate (Mild Systemic Exposure	Severe (Moderate Systemic Exposure	Very Severe
Respiratory system--moderate chest tightness, bronchial secretion, expiratory wheeze, cough, rhinorrhea, and salivation. Eye--maximal miosis. Gastrointestinal tract-- Neuromuscular system--easy fatigue, slight weakness (especially with exertion), muscle fasciculations, and twitching. Central nervous system--excessive dreaming, insomnia (partly from eye pain), and anxiety.	Eye--same as "moderate". Respiratory system--severe chest tightness, lower sternal pain. Gastrointestinal tract--vomiting, cramps, diarrhea, heartburn. Urinary system--frequent urination. Neuromuscular system--muscular weakness, tremors, and dyspnea. Central nervous system--same as "moderate," plus jitteriness, emotional lability, giddiness, headache, memory impairment, slow recall slow reaction, and ataxia.	Central nervous system--the principal effects are convulsions, collapse, and paralysis.

*The various degrees of incapacitation resulting from exposure to GB that require significant medical treatment are defined by the nature and degree of toxic symptoms.

Mental confusion, incoordination, and collapse may occur so quickly that the casualty cannot perform self-aid; first-aid must then be administered by the other personnel. To save as many nerve gas casualties as possible, specific self-/first-aid measures must be initiated immediately or nearly immediately on the battlefield.[1] These measures must then be reinforced, with minimal or no interruption, by continuing resuscitative[2] and symptomatic treatment[3] provided by medical personnel.[4]

- Vesicant agents. Predominant symptoms of casualties caused by vesicant agents are the presence of toxic chemical burns; high incidences of eye injuries (86 percent of World War I mustard casualties); respiratory damage; and contaminated condition of patients. The insidious nature of most vesicant agents can delay recognition of exposure and treatment of casualties. In some cases, signs of injury may not appear for several hours. Consequently, vesicant agent effects can be more serious than is immediately apparent. The multiple traumatic effects of vesicant

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[1]Administration of one of the approved antidotes (atropine; benactyzine hydrochloride, atropine sulfate, TMB-4 (TAB)); artifical respiration; ocular irrigation (liquid nerve agent in eye); decontamination of the skin, as soon as possible.

[2]Control of respiratory failure (assisted ventilation) and hemorrhage; administration of antidote(s); decontamination, particularly ocular and facial.

[3]Management of convulsions; relief of apprehension; treatment of ocular symptoms.

[4]For details pertaining to self-aid, first-aid, and medical treatment of CW casualties. See NAVMED P-5059, NAVMED P-5041 and the Emergency War Surgery Handbook.

agents (skin, lung, and eye damage) increase the requirements for management and care of vesicant agent casualties. Medical treatment of such casualties is detailed in references cited previously; principles for their medical management are addressed later herein.

- Blood agents. The Soviets are believed to have a blood agent (AC--hydrocyanic acid). This agent is particularly adapted to delivery of "crash" concentrations by large-volume delivery means such as multiple rocker launchers in order to achieve almost instantly the high agent concentrations required for maximum effects. In high concentrations, AC may cause immediate death after inhalation of a few breaths. Typically, either death occurs quickly or recovery takes places within a few minutes after removal from the toxic atmosphere. Accordingly, it is reasonable to expect that exposure to AC should not contribute a significant portion of CW medical workloads.

4.3 NBC MEDICAL WORKLOAD

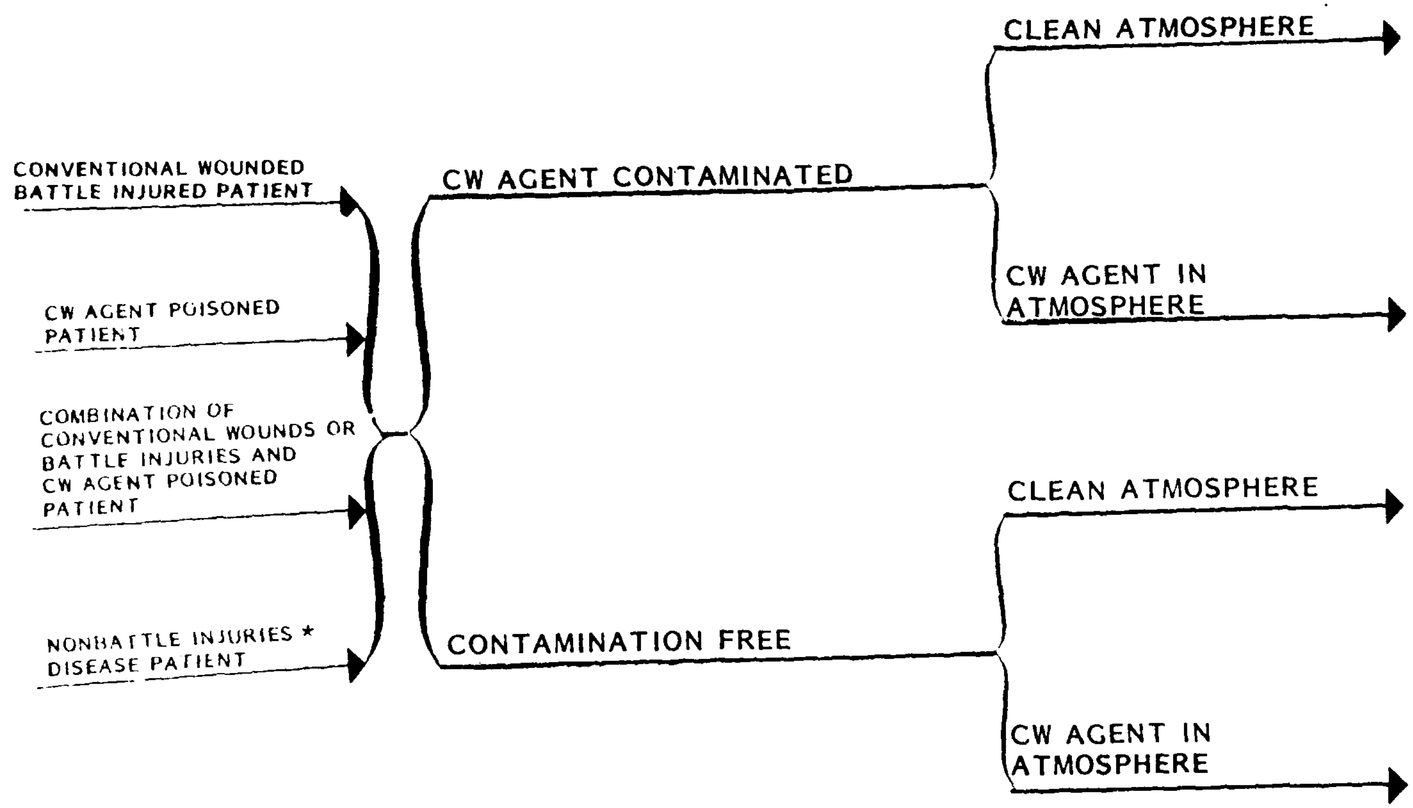
The magnitude and composition of the medical workload on an integrated battlefield is highly variable. The success of preassault operations, the reaction of the enemy and especially the choice of weapons mix employed by the enemy all heavily influence the casualty rate and type. However, using the design criteria established in paragraph 4.1, it is possible to set reasonable limits to the types and proportions of casualties that would be generated in a sustainable but heavy-load situation.

The most critical period for medical support is during the first day of an assault. It is difficult to imagine a situation in which the enemy effectively employs nuclear weapons during the first or second day of an amphibious assault that does not result in unacceptable casualty levels and thereby cause the operation to be aborted. On the other hand, prompt reaction by an enemy with normal biological agents would likely have minimal effect during this period because of the long time required to produce casualties.

The most serious threat for medical support system design, therefore, is a combination of conventional and chemical weapons employment by the enemy. Soviet doctrine prescribes the integrated employment of CW and conventional weapons thereby expanding the spectrum of patient categories in the medical system. These patients can be divided into the following categories with respect to cause:

- Conventional wounds and battle injuries
- CW agent poisoned
- Combination of the above
- Disease and non-battle injuries

However, these patients may or may not be contaminated, therefore, the medical support system can be faced with a wider variety of patient categories based on special handling requirements. The problem of treatment and handling these patient categories will be further compounded by the requirement for NBCD measures in the medical support element. The final patient workload which could be postulated for the medical support system in an NBC threat environment is shown in figure 4-1. An increase in the non-battle injuries could be expected because of a new category of casualties



*Includes radiation sickness, BW agent sickness, and casualties caused by NBC defense measures.

Figure 4-1. <u>Possible Patient Workload for MAGTF Medical System in CW Environment</u>

created by NBCD measures. A recent report prepared by the U.S. Army, 8th Infantry Division (mechanized) discussed patient categories evaluated during a field exercise.

> "Medical personnel whether unit aidmen, members of the Battalion Aid Station or from a section of the Division Clearing Station will see two main groups of casualties. The first group is directly related to chemical warfare. The second group is related to NBC defensive measures. In the first group, medical personnel could expect to see those who are pure chemical casualties resulting from poor training, or chemical defense equipment problems. The pure conventional casualty will always exist, but it may be impossible to determine if he arrives at the medical element in a chemical ensemble. Some conventional casualties may arrive wearing contaminated clothing. Mixed casualties could result from casualties becoming contaminated in the area of their injury. Psychiatric casualties could be expected to increase in chemical warfare. The second group of casualties could result from NBC defensive measures. These include heat stress, agent treatment overdose, vehicle accidents from driving while masked and psychiatric problems from being encapsulated in the chemical ensemble."[5]

Conventional weapons and battle injuries can be expected to produce a treatment ratio of around 4:1 (i.e., four patients introduced into the medical system for each casualty killed in action). Under certain circumstances this ratio could vary from 2.5:1 to 5:1, but the ratio 4:1 is quite representative of experience in intense combat typical of an amphibious assault. Of these conventional casualties within the ground assault elements of a MAGTF, about half can be attributed to small arms and other direct fire weapons, and the other half to supporting arms.

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[5] Report Decontamination - Refit on the Integrated Battlefield. Headquarters, 8th Infantry Division (Mechanized). 4 November, 1981.

If the enemy chose to use few or no chemical weapons against trained and prepared troops, chemical casualties and contaminated casualties would be minimal. Aside from some small increase in non-battle injuries (heat casualties, psychiatric, accidental treatment overdose) the medical workload would be the same as for purely conventional operations. If, on the other hand, the enemy supporting arms are devoted primarily to chemical weapons, both the magnitude and the distribution of the medical workload can be expected to change.

Using the casualty assessment technique (CAT, see Volume 2), with chemical effectiveness data from FMFM and North Atlantic Treaty Organization (NATO) documents, supporting arms using chemical weapons against trained and prepared troops were assessed to be nearly five times as effective in producing casualties as conventional supporting weapons. In addition, chemical weapons are estimated to be about 1/3 as effective as conventional high explosive rounds in producing fragment-wound casualties. Because of the way supporting arms are employed with chemical weapons, most supporting arms fragment-wound casualties can be expected to be agent-poisoned as well, and few small arms casualties will be subject to immediate agent poisoning. Under cool weather conditions, (low heat stress), non-battle injuries among well-trained troops can be expected to increase very little to about 1/3 the number of casualties from an all-conventional situation during the actual assault. Summarizing all these considerations, the breakdown of casualties by cause for a "worst case" chemical plus conventional weapon amphibious assault (first days) is shown in table 4-4.

Table 4-4 also shows how the treatment ratio (the number of patients divided by the number of those who die before becoming patients) differs

Table 4-4. Breakdown of Casualty Population by Cause for Heavy Weapon Use

Casualty Category	Casualty Proportion, Percent	Treatment Ratio	Patient Proportion, Percent
Conventional wounds (primarily small arms)	15	4:1	14
CW agent poisoning	67	6:1	70
Conventional plus agent poisoning (primarily support arms)	8	1:1	5
Non-battle injuries/ illness	10	9:1	11

for the different casualty categories. Conventional (small arms) casualties are expected to exhibit the historical ratio, 4:1, which has held f irly constant from Korea and Vietnam experience. Casualties exhibiting agent poisoning only among prepared troops are expected to exhibit high rates of survival for two reasons: (1) agent concentrations within target areas, and even more so in the larger drift areas, are not expected to reach lethal levels uniformly, and (2) even poorly performing NBC defense measures can be expected to reduce the exposure below ambient concentrations. A treatment ratio to 6:1, or higher, is a reasonable estimate of survival (see Volume 2 for detailed discussion); however, actual experience could provide completely unexpected data. By contrast, the survival rate, even to preliminary medical aid, of a combination casualty is expected to be very low. Those wounded by contaminated shell fragments are unlikely to survive the double shock of the wound and essentially intravenous agent

poisoning. Even uncontaminated fragments will open a susceptible path to contamination in the wound as well as in many cases breaching the protective ensemble and reducing the patient's capability for NBCD. An assumption of 50 percent survival to initial treatment may be optimistic, but is appropriate for this study to ensure handling of this type of casualty. Non-battle injury and disease typically have very high treatment ratios. In climates without severe heat stress this characteristic will remain. An assumption of 9:1 is appropriate for this study even though specific data are lacking.

The resulting distribution of patients by cause category, also shown in table 4-4, should be appropriately balanced to represent this aspect of the medical workload for a situation with high chemical weapon usage. The next consideration is to define the proportion of patients with liquid agent contamination on them. From considerations of tactical employment of chemical weapons explored with the CAT, the ratio of chemical casualties in the target areas of persistent chemical agent strikes to chemical casualties caused by the downwind effect was approximately 1:3 during the first hour of the initial strike. During subsequent hours of cloud drift and non-persistent agent strike this ratio drops to 1:12. Therefore, in a tactical situation (as represented by the assumptions of cloud drift in FMFM 11-3) the number of liquid contamination free patients will far exceed the number of liquid contaminated patients posing a risk to medical personnel. Whether these patients can be infallibly identified so as to reduce both the risk and the requirement for decontamination prior to treatment is another aspect and will be dealt with later.

The final determinant of casualty handling procedures is the possibility of the medical facility being in an area that could have chemical agent vapor concentrations in the air. The tactical representation of chemical employment evaluated with the CAT also represented the variability of wind direction and speed typical of littoral regions. Agent clouds subject to these wind variations spread, mix, and extend to provide substantial agent vapor risk over most of the FBHA. In the tactical situation examined (using FMFM 11-3 data) significant casualty risk to unprotected personnel from vapor in the atmosphere covered 3/4 of the test terrain, and virtually all of the committed force, less than 24 hours after H-hour (and less that 12 hours after the first chemical strike). Detailed results are shown in Volume 12. Even if special care could be taken to establish medical facilities in regions with clean atmosphere initially, this condition could change with little notice, and the vapor risk could continue indefinitely.

The conditions that characterize the medical workload for a period of intense chemical warfare are summarized in figure 4-2. From the information in figure 4-2 it can be determined, for example, that about 25 percent of the patients will be free of agent poisoning and liquid contamination, and that a few hours after a strike about 69 percent (92 percent of 75 percent) of the chemical agent patients will be uncontaminated by liquid agent.

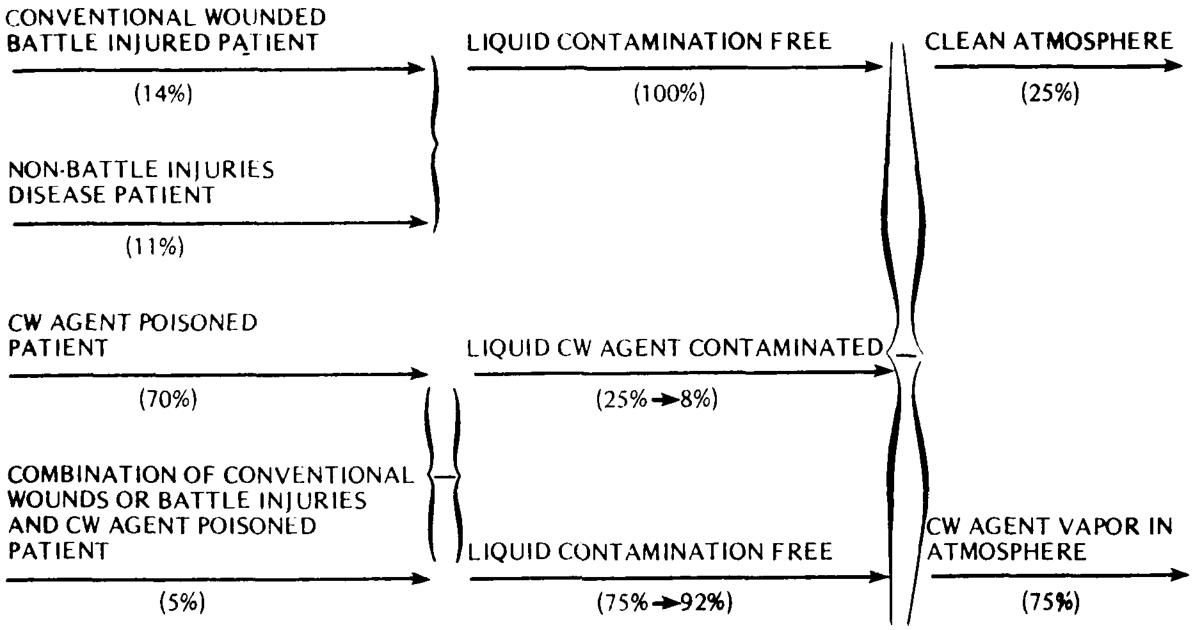


Figure 4-2. Medical Workload for Intense CW as Developed in the CAT Using FMFM 11-3 Data

The data of figure 4-2 represent a reasonable projection of the currently accepted weapons effects data (FMFM 11-3). However, at the direction of the study sponsor, the work done at Dugway Proving Ground which modifies the estimates of both liquid and vapor persistence was evaluated. Using these new Dugway data and the CAT to assess the results of heavy enemy use of chemical weapons results in the medical workload characteristics shown on figure 4-3. The breakdown of casualties by cause shows relatively little change from figure 4-2 (e.g., 70 percent agent poisoned patients instead of 75 percent), but both liquid contamination and vapor drift are substantially different. Compensating for the relatively low effectiveness

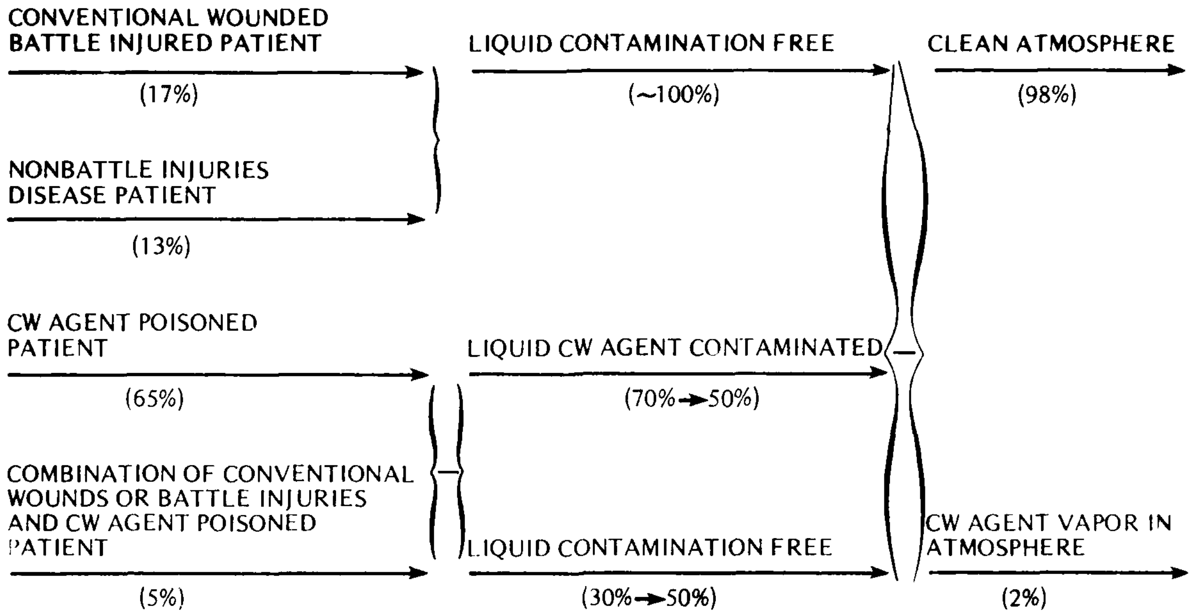


Figure 4-3. <u>Medical Workload for Intense CW as Developed in the CAT Using Dugway Proving Ground Data</u>

of vapor clouds, according to the Dugway data, the enemy fire support system would likely make heavy use of thickened nerve and vesicant agents. As a result, a high proportion of chemical casualties would be contaminated by liquids or come from contaminated areas, possibly as high as 70 percent initially and reducing to about half as the limited vapor clouds form, drift, dissipate, and are formed again from the frequent succeeding strikes. At any given time, however, the extent of vapor cloud coverage of the battle area is minimal, about 2 percent as contrasted with the 75 percent shown in figure 4-2 (see Volume 2).

The chemical casualties accepted by the medical system for treatment will include those with symptoms of varying severity as defined in table 4-3. The actual severity of symptoms for any individual casualty depends both on the agent type and dose absorbed, and on the individual patient's reaction to the agent. Data for the distribution of patient reactions to nerve agent poisoning are given in Volume 2. Information of that type can provide some indication of the distribution of casualties by severity. One technique for doing so is illustrated in Volume 2. The CAT provides an example of the distribution of vapor risk on the battlefield. What are unknown are the effectiveness of less than perfect NBC defense protective measures in reducing the total dose absorbed, and the success that can be achieved in arresting very severe symptoms by prompt treatment and thereby improving the treatment ratio. A conservative assumption for faulty NBCD equipment or procedures is that they still would reduce the agent dose received to about half of what would have been absorbed without any protection. If it also is assumed, as mentioned above, that about 14 percent of all chemical casualties are KIA before any treatment can be administered (treatment ratio of 6:1), then the proportion of patients exhibiting very severe symptoms (possibly requiring resuscitation) could run from 0 percent (no heavy dose survivors), in situations where the risk is from drifting vapor, to about 15 percent where most casualties are caused by dense concentrations in or near target areas. About 70 to 75 percent of the patients should exhibit moderate symptoms, with the balance severely affected.

As an illustration of the effect of these factors on the medical workload, it is possible to construct an expected distribution of patients under conditions that would stress the medical system to its design limit. In a reason-

able MAF amphibious operation, approximately 7,500 troops would be put ashore in the first 24 hours. A sustainable, if severe, casualty rate of 25 percent could result in 1,875 casualties in this period. (Such a high casualty rate could result in early and heavy commitment of reserves, but no additional casualties need be assessed to continue this illustration.) If the enemy were relying heavily on chemical weapons for supporting arms, and if the troops were well trained and equipped for NBCD, then the maximum chemical patient workload could be the patient population distribution shown in table 4-5. The patient load receiving some form of medical treatment would be 1,566. Of these patients, approximately half would exhibit only moderate symptoms of CW agent poisoning, with a prognosis of effects lasting about 1 to 3 days (table 4-2). On the other hand, about ten percent of the patients would exhibit very severe symptoms, with the attendant requirement for intensive care and early evacuation. The other patient categories in table 4-5 similarly impose specific characteristics and requirements for patient handling. A medical system capable of handling this patient distribution under threat of chemical vapor and liquid contamination, and equally prepared to handle a similar load of casualties from a no-chemical-threat situation, would provide adequate support for all reasonable anticipated situations short of mass casualties.

Table 4-5 Estimated Patient Population Distribution for High-Casualty, High-Chemical-Use Situation*

Casualty Category	Casualties	Patients	Chemical Agent Symptoms			
			Very Severe	Severe	Moderate	None
Conventional wounds	281	225	-	-	-	225
Non-battle injuries/ illness	188	169	-	-	-	169
CW agent poisoning	1,312	1,125	169	169	787	-
Conventional plus CW	94	47	-	8	39	-

*Data represents maximum sustainable casualty rate (25 percent) among the 7,500 troops landed in 24 hours in a MAF operation.

4.4 MAGTF MEDICAL ASSETS AND CAPABILITIES

The commander of the MAGTF is ultimately responsible for the health of his command. The commander is provided medical personnel and equipment to assist him in fulfilling this responsibility. The medical support for the MAGTF is planned to conform to the tactical plans and policies of the commander.

The medical assets which are normally found in a MAGTF can be summarized as follows:

- Medical personnel are organic to all combat and combat support organizations of battalion/squadron size or larger.
- Combat service support organizations have medical personnel assigned in accordance with their mission and the mission of their parent command.
- Medical support capability above the battalion/squadron level is provided by the medical battalion of the force service support group (FSSG), group aid station (GAS), and Marine air base squadron (MABS).
- Medical material support for all combat, combat support, and medical battalion services is provided by the medical logistics company, supply battalion, FSSG.

A closer look at each one of the medical elements will provide a basis for assessing the current NBC casualty handling capability of the medical support system.

The hospital corpsman is the leading edge of the medical support system. He will be the first to contact a casualty entering the medical support system. The company and platoon corpsman perform first aid such as controlling

hemorrhage, splinting fractures, applying battle dressings, giving morphine, and in some cases, administering supporting fluid. They must also complete field medical cards on all casualties, and direct evacuation, if appropriate.

The battalion aid station (BAS) is the next element in the medical support system. The BAS is staffed by two surgeons and 21 hospital corpsmen of the battalion medical section. The BAS may be bypassed at times depending on the mode of transportation used in evacuation. The functions of the BAS are:

- Recording of all casualties received.
- Examining and sorting casualties for disposition. (Triage)
- Providing temporary shelter and emergency treatment such as dressing or redressing wounds, applying or adjusting splints, resuscitation, and administering morphine, antibiotics, tetanus prophylaxis, and plasma or plasma substitutes.*
- Initially treating nonbattle casualties and holding those whose condition will permit early return to duty.
- Treatment of the majority of acute combat psychiatric cases.
- Providing routine sick call for battalion personnel including immunization as required.
- Maintenance of health records of battalion personnel.
- Providing replacement for the company medical teams.

*Common battle injuries expected are missile and fragmentation wounds burns, lacerations, amputations, fractures, and psychiatric cases.

The evacuation station (ES), usually the first external medical support to be established ashore in an amphibious assault, is a combination of a shock/surgical team and an evacuation platoon from a medical company. Essentially the station operates as a central collection and staging facility for patients requiring seaward evacuation. The ES provides an evacuation capability that may be utilized either on the beach or at a helicopter support team landing zone. Their mission is to collect patients from forward areas or along the beach and transport them to the evacuation station. The functions of the ES are:

- Perform triage of patients entering the evacuation station.
- Perpetuate treatment begun at the BAS.
- Perform basic emergency surgery (e.g., ligation of blood vessels), if required, to maintain life of patient while awaiting evacuation to either casualty receiving and treatment ship (CRTS), or designated hospital ship.
- Rapidly process casualties into the evacuation chain, via small craft or helicopter, utilizing an amphibious task force medical regulating center.
- Initiate intravenous (IV) therapy, redressings, resuscitation.
- Replace evacuation material to forward echelons; e.g., litters and blankets.
- Provide aid station support for elements adjoining the evacuation station; e.g., beach shore party elements and helicopter support teams.

When the tactical situation ashore permits, usually after the establishment of the division command post, the medical company is established ashore. This

unit can provide emergency and resuscitative treatment and temporary hospitalization facilities for patients until they are evacuated. The function of the medical company is to establish and operate an emergency, surgical field hospital. It consists of 2 operating rooms and has a 60-bed ward holding capability. Surgical disciplines include general surgery and orthopedic surgery.

A full range of services are included in the hospital:

- Triage
- Laboratroy
- X-ray
- Pharmacy
- Shock and debridement
- Presurgical holding
- Postsurgical intensive care
- Ward nursing and evacuation preparation care
- Minor surgery
- Major surgery
- Sterile supply

The intensity of surgery is directed toward emergency life/limb/organ saving procedures, and patient stabilization for evacuation to a definitive care facility.

When the FBH has been determined to be secure, and consistent with the expected duration of subsequent operations ashore, medical support is upgraded by the landing of the hospital company. The hospital company is the major link in the evacuation chain and will usually be located close to an airfield. In fact, it is essential for a suitable airfield to be available for the hospital company to conduct sustained operations. The hospital company will provide the MAGTF with a land-based medical support capability essentially independent of sea-based facilities. The company is configured to provide a 6-surgical suite, 200-bed emergency surgical hospital. Surgical disciplines include general surgery, orthopedic surgery, ophthalmic surgery, neurosurgery, thoracic surgery,

and oral surgery. The intensity is directed toward life/limb/organ saving surgery and patient stabilization for evacuation to a definitive care facility or return to duty.

Other disciplines include anesthesia, internal medicine and psychology. A full range of ancillary services exist within the hospital; e.g., laboratory, pharmacy, X-ray, dermatology, casting, nursing, and emergency room procedures.

Major functions of the hospital company are:

- Receiving, sorting and emergency care (Triage)
- Diagnostic work ups
- Shock and debridement/presurgical holding
- Surgery
- Minor surgery
- Postoperative intensive care
- Ward nursing/evacuation preparation
- Sterile supply

If the amphibious operation by the MAGTF envisions a sustained land battle additional medical support facilities would normally be provided in the form of an Army or Navy hospital or functional component.

The medical support for the MAGTF which may be involved in the handling of NBC casualties can be summarized as shown in table 4-6.

Table 4-6. Medical Support for a MAGTF

HOSPITAL CORPSMAN	BAS/ES	MEDICAL COMPANY	HOSPITAL COMPANY
FIRST AID	TRIAGE	TRIAGE	TRIAGE
ADMINISTER FLUIDS	EMERENCY TREATMENT	EMERGENCY SURGICAL &	SURGICAL TREATMENT
DIRECT EVACUATION	ADMINISTER FLUIDS & DRUGS	RESUSCITATIVE TREATMENT	PATIENT STABILIZATION
	EVACUATION	TEMPORARY HOSPITALIZATION	HOSPITAL ANCILLARY SERVICES
		EVACUATION	EVACUATION

4.5 NBC CASUALTY HANDLING DEFICIENCIES

In each of the medical support elements discussed above, there are deficiencies for the specialized treatment of NBC casualties, and no dedicated capability for the handling of contaminated patients, or for providing medical support in a contaminated environment. Because of these deficiencies the current medical support for the MAGTF is unable to provide an adequate NBC casualty handling capability. It is not equipped nor trained to conduct medical operations in a contaminated environment. The following is a summary of the major deficiencies in NBC casualty handling in the MAGTF.

In most cases the hospital corpsman has had little specialized training in the treatment and handling of CW casualties. He does not carry adequate supplies of nerve agent and blood agent therapy. Additionally, he does not have supplies of decontaminants available for emergency decontamination of the casualty, and a wound dressing cover that will protect the wound from contamination. While some of these items are treatment-oriented they impact on the ability of the medical support system to process CW casualties.

At the BAS/ES, there is a requirement for the following capabilities which are not currently available:

- Emergency patient decontamination (in excess of that available in the individual's decontamination kit).
- Vital signs monitor for patients in NBC protective ensembles.
- Administration of fluids in a contaminated environment.
- Automatic multi-patient resuscitation.
- Contamination monitor.

The members of the BAS/ES must be trained and equipped to perform their medical support in a contaminated environment. They must have adequate supplies of CW agent treatment items and must have a means of providing overhead cover which is impermeable to CW agents.

The medical company has no collective protection capability and it lacks the necessary equipment and people to perform the required decontamination for its own equipment and personnel. As has been noted for other medical elements, the personnel of the medical company have had only minimum NBCD training. This is inadequate to prepare them to perform medical support on contaminated patients or function in a contaminated environment. The medical company has the same capability deficiencies as the BAS/ES previously noted. In addition, it requires the following capabilities:

- Patient decontamination.
- Contamination free patient treatment facilities.
- Contamination free patient holding facilities.
- Contamination free storage capability for critical medical supplies.
- Patient protection from CW vapor and other contamination during evacuation.
- Protection for medical personnel from low level vapor hazard which imposes minimal degradation.

The current capability of the hospital company reflects the same deficiencies as the medical company. The requirement for collective protection remains critical for the hospital company to perform its mission in an NBC environment. The larger patient holding capability and the need to insure that only "clean" patients are evacuated to definitive care facilities will place a great stress on any decontamination and collective protection facilities.

These deficiencies formed the general guideline for the study team in developing the recommendations for the MAGTF NBC casualty handling system. The need to provide or improve a capability to meet the type and level of projected medical workloads described in paragraph 4.3 has been the fundamental factor in this analysis. In some cases, a change in operational procedures can correct a deficiency; while in many cases, equipment and personnel improvements are required.

4.6 NEW DEVELOPMENTS IN NBC CASUALTY HANDLING

During the time frame of this study, the military services have become acutely aware of the shortcomings in equipment for treatment and handling of patients in an NBC environment. Several conceptual and developmental initiatives have been programmed by the Services to solve some of the complex problems in the areas of:

- Treatment of CW casualties
- Medical operations in a CW environment
- Handling of contaminated patients
- Patient decontamination
- Patient contamination monitoring

The study team has reviewed (where possible) these areas with the various R&D material development agencies of the U.S. Services and NATO allies. The following items appear to show some promise of being appropriate for USMC application.

4.6.1 United Kingdom developmental NBCD items.

Disposable facelet. Made of activated charcoal cloth similar to the United Kingdom overgarment. For short term use in light vapor hazard area. Reduces breathing strain and eliminates visual degradation imposed by standard protective mask.

NBC casualty evacuation bag. Made of activated charcoal cloth similar to United Kingdom NBC overgarment. The bag has a full-length velcro fastener and a large plastic window for patient observation. This item also comes in a one-half bag configuration.

Chemical agent monitor (CAM). The CAM is a small hand-held chemical vapor detector that is very sensitive and can detect low levels of all known nerve and blister agent vapors.

Multi-outlet automatic resuscitator. An automatic resuscitator designed to deliver positive pressure resuscitation either oro-nasal (with mask) or endotracheal (with tube) to the patient. This item can be vehicular mounted or man-portable. It requires an electric power source.

4.6.2. Canadian developmental NBCD items.

Improved heart rate monitor. A hand-held instrument which will measure a patient's heart rate through multi-layers of clothing material, including the protective overgarment and the NBC casualty evacuation bag.

Blood pressure monitor. A modification to the cuff device of blood pressure measuring equipment which will allow measurement of the patient's blood pressure through the protective overgarment or NBC casualty evacuation bag.

4.6.3 United States developmental NBCD items.

Bandage for CW environment. A wound dressing that will have an outer layer to prevent wound contamination by NBC contaminants.

Surgical gloves for CW environment. Surgical gloves for medical staff that would prevent contamination of the wearer when handling contaminated patients and still allow the required manual dexterity and sensitivity.

CW dosimeter. A dosimeter type device that will measure accumulated exposure to CW agents. This device would be worn by medical staff and

would measure low levels of CW agent vapors and provide an indication of cumulative CW agent exposure.

Body fluids micro-processor. A device to detect patient exposure to CW agents by means of body fluid analysis.

Administration of fluids in a CW environment. A system designed to provide intraveneously uncontaminated fluids to a patient in a contaminated environment.

Contamination detection for medical stocks. A device or means of detection of low levels of contamination of medical supplies.

Patient decontamination. A system which will provide a safe means of litter patient decontamination. Two types of decontamination are being considered using a liquid or dry decontaminant.

Individual patient resuscitation. A portable hand-operated single patient resuscitation device which works on a bellows principle.

Multi-patient resuscitation system. An automatic device which would provide pressurized clean air to patients requiring assisted ventilation. This item could be used in both air and ground evacuation vehicles and medical support facilities.

Several other developmental items which have been mentioned in chapters 2 and 3 appear to offer a significant improvement in the MAGTF medical service to NBC casualties. Because of their special interest to medical service planners, these items are repeated below:

XM15 interior surface decontamination system (ISDS). A device to allow vehicle crew members to decontaminate the inside of vehicles, vans, aircraft, shelters, and could be useful for medical evacuation vehicles. This system will utilize the hot-air principle and has an IOC of May 1987.

XM17, LDS/Norwegian NBC Sanator. A portable (330 pounds), compact, gasoline driven pump and water heating unit which can draw water from any source and deliver it at controlled temperatures up to 120°C and pressures up to 100 pounds per square inch, gage (psig). This decontamination device is currently being tested/evaluated by both the Army and Marine Corps. In November 1981, FMFLANT conducted an independent field evaluation of the XM17. Preliminary results of this evaluation indicate that the XM17 performance was acceptable. The XM17's lightweight and small cubic area make it an ideal system for Marine units and could be used to provide hot water to medical and hospital companies and for patient decontamination as well as providing a decontamination capability for medical personnel and equipment by the use of a hot water wash down.

Marine Corps expeditionary shelter system (MCESS). The MCESS is also being considered for a form of collective protection as discussed in chapter 3. Some of the shelters in the MCESS could be utilized for medical support to satisfy some of the collective protection requirements. In recognition of this possibility, HQMC has established a Required Operational Capability (ROC) for a Marine Corps environmental-controlled medical system (MCECMS).[6] This ROC provides the guidance for development of the ECMS utilizing the small shelters of the MCECMS. The basic functional components of the medical company and the hospital company:

- Administrative unit
- Emergency treatment unit
- Intensive care ward
- Medical supply unit
- Orthopedic treatment unit
- EENT treatment unit
- Laboratory/pharmacy unit
- Oral surgery unit
- Receiving unit
- Surgical unit

[6] Letter 19 January 1979, HQMC, Required Operational Capability (ROC) for Environment-Controlled Medical System, (No. Log 1.13A).

- Sterile preparation unit
- X-ray unit
- Patient wards

Portable electrostatic CP system. The portable electrostatic collective protection system (PECPS) provides protection against CB agents. Personnel, equipment, and stored material are contained within a double layered fence which is set up around and above the area to be protected. The overhead is covered with a barrier type material. The fence produces a corona discharge between the screen layers which ionizes oxygen molecules. The open nature of the fence allows light and air to pass through the fence structure, creating a protected, ventilated environment within. This type system, sometimes known as the corona discharge system, is being developed for MCDEC and is scheduled for some testing in FY 82-83.

Navy-Marine Corps shower unit. This item is being developed at the U.S. Navy Civil Engineering Laboratory, Port Hueneme, California, (figure 2-6, page 2-47,) may be satisfactory, as a part of the decontamination process for patients and medical personnel. The development center at MCDEC should follow the development of this item for NBCD application.

All of these items seem to offer some solutions to the problem of handling and treatment of NBC casualties (primarily CW) in the MAGTF. Perhaps the most comprehensive of these items is the MCECMS which would correct a significant deficiency in the system: the lack of collective protection. However, this item alone will not solve the problem. As an example, the MCECMS would be of little value without a compatible decontamination facility for both patients and medical staff, and a successful decontamination capability will be dependent upon an effective detection capability.

In the development of the study recommendation for the NBC casualty handling system, all of the developmental collective protection system (CPS) have been evaluated and, where appropriate, have been included in our recommendations in paragraphs 4.7 and 4.8 of this chapter.

4.7 NBC CASUALTY HANDLING SYSTEM FOR THE MAGTF

The casualty handling system which will meet the challenge of the integrated battlefield must provide for the treatment and handling of NBC casualties as well as ensure effective medical support in a contaminated environment. In developing the system, the fundamental consideration is: "what is it that determines the medical workload level to be used as a system design criterion?" An amphibious force should function as a well balanced system during the critical assault and buildup ashore phase. All elements of the system, of which medical support is but one, should function properly as long as the casualty rate and equipment losses do not exceed the ability of landing force commander (CLF) and subordinate commanders to replace, reinforce, commit reserves, and otherwise compensate for losses <u>and still accomplish the mission</u>. This limiting rate is generally determined by force planners on the basis of combat unit cohesion, the dynamics of force commitment, staying power, mission, and other such basically experiential factors. This casualty rate, at which the force is expected to continue to function effectively, should serve as a design point for the medical system. In a properly planned assault, the <u>expected</u> casualty rate should be substantially below the programmed limiting (design) rate or there is, literally, no margin for error. On the other hand, it clearly makes no sense to design the medical system to function smoothly as the last combat unit dissolves into sets of casualties and litter-bearers, regardless of what the <u>maximum</u> conceivable casualty rate might be.

Based on our analysis and various historical examples, the following factors define the design point selected for the proposed medical support system for NBC casualty handling in the MAGTF:

- Maximum sustainable casualty rate for assault waves (regiment-sized units) can run as high as 25 percent on D-day or D+1.
- Maximum sustainable casualty rate for division-sized units conducting an amphibious assault is 5 to 10 percent per day over a several day period.
- Patients resulting from these casualty rates should occur at an expected casualty treatment ratio for conventional weapons of approximately 4:1.

Mass casualty situations, which may result either from conventional or NBC weapons use, are by definition not sustainable and may result in mission failure. Therefore, they should not be used as design conditions for medical support.

In the development of the NBC casualty handling system, certain other principles were identified which, while not a functioning element of the medical support system, will to a great extent, determine its success or failure in an NBC environment. These principles are summarized below.

- The individual NBC protective ensemble provides the Marine his best chance of survival in an NBC environment, whether or not he is a casualty. Every effort must be made to insure the integrity of the NBC protective ensemble is maintained until such time as the individual (casualty or not) is in an NBC-agent-free environment.
- Complete decontamination of personnel is a time and manpower intensive effort. Therefore, it should be accomplished as far

from the FBHL as the situation permits and then only when decontaminated personnel are assured access to an NBC-agent-free environment. This applies, as well, to patients in the medical system.

- The buddy aid system provides an important adjunct to medical support system and maximum use of this capability must be encouraged. However, buddy aid must be limited to only <u>emergency short term actions</u> that will not substantially degrade the Marines' mission performance.
- Many NBC contaminants are pervasive in nature and difficult to detect. Therefore, personnel and equipment must be determined to be contamination free before entry is permitted into a contamination free facility.

Finally, in considering the requirement for the NBC casualty handling system the following goals are proferred:

- •• Utilize critical medical personnel at their highest level of capability.
- •• Minimize the injuries resulting from NBC agents while at the same time preventing the aggravation of conventional injuries.
- •• Protect patients and the personnel handling contaminated casualties or working in contaminated areas from further spread of contamination or toxic vapors.
- •• Avoid the spread of contamination into treatment facilities.
- •• Continue essential medical services to the maximum level possible in an NBC environment.

Keeping in mind all these factors, the study team has developed a recommended system concept for NBC casualty handling in the MAGTF. This system

is discussed as the casualty moves through and interacts within its elements.

4.7.1 Self-aid and buddy aid.

Self-aid, the Marine's first reaction to becoming a casualty, is that immediate action the affected person can take using the equipment he usually carries, without assistance from other persons. Buddy aid is any assistance which can be rendered to casualties by personnel with no formal medical training. It is important to note here that unless all Marines are trained and can perform effective, self and buddy aid for conventional and NBC weapons effects, no medical system can hope to handle the types and number of casualties which could be generated by the introduction of NBC weapons. The following actions are considered self/buddy aid in a CW environment where contamination is confirmed or suspected:

- Establish or reestablish the integrity of the NBC protective ensemble of the casualty.
- Rapid emergency decontamination of any exposed skin.
- Administer emergency first-aid to include appropriate CW agent therapy if casualty displays proper symptoms. This action is performed in the following sequence:
  - Administer proper CW agent therapy using the medication carried by the casualty when available.
  - Decontaminate the gloves before touching the wound.
  - Decontaminate the wound and surrounding clothing, cutting away sufficient material to allow complete decontamination.
  - Decontaminate the outer package of the field dressing before opening it.

- •• Apply the dressing to the wound taking care to avoid contamination of the bandage ties.
- •• Cover the dressing with some CW agent resistant material to avoid contamination during evacuation.*

It is at this point that the first, although crude, triage must be performed by non-medical personnel, (i.e., if a CW casualty is found unconscious and not breathing, there is nothing to be done since he would be classified as expectant.) After completing the aid outlined above, the Marine rendering buddy aid must resume his normal mission and leave the casualty for the corpsman.

4.7.2 Litter bearers.

The litter bearers may be the next contact the casualty has with the medical system. The litter bearer, while not part of the battalion medical section, operates under the supervision of the battalion surgeon. Normally, medical personnel (corpsmen) from the battalion medical section are assigned to provide direction and guidance in the evacuation functions. The litter bearers are responsible for the collection and evacuation of casualties in the unit area. They should be trained in NBC casualty handling procedures prior to combat operation.

In some cases, the litter bearers may find a casualty who has had no assistance. In such cases, the litter bearers must be prepared to perform buddy aid (per paragraph 4.7.1) for the casualty, where required, prior to evacuation. In all cases, the litter bearer must ensure the NBC protective ensemble of the casualty is maintained during his evacuation. Additionally, he should be trained in procedures to limit any contact or spread of contamination in his handling and moving of the casualty.

*The bandage for CW environment discussed in paragraph 4.6.3, will fulfill this requirement when available.

4.7.3 Hospital corpsmen.

The hospital corpsmen generally will be the first medical department personnel in contact with the casualty. Like the litter bearer, he may find a casualty who has had self/buddy aid or he may be required to provide the initial emergency aid to an untreated casualty. The corpsmen must be trained to carry out his own NBCD measures and still render appropriate emergency medical care to the casualty as he would in any combat environment. In addition to caring for conventional injuries, the corpsmen must take certain actions unique to CW casualties. These actions initially follow the basic steps outlined in paragraph 4.7.1.; however, the level of emergency care will be greater than that performed by self/buddy aid. The corpsmen should have additional supplies of CW agent treatment available so that he may administer additional doses as he deems necessary.

In providing additional medical care for casualties who have had initial self/buddy aid, the hospital corpsmen should perform the following actions:

- Ensure that the casualties' NBC protective ensemble is maintained.
- Administer additional CW agent therapy as required.
- Check, (and replace were required), any wound dressings insuring the CW agent resistant material is covering the bandage.
- Establish, where possible, evacuation priorities for CW casualties by an initial triage as follows based on the overall condition of the casualty:
  - Minimal -- low agent exposure, minimal symptoms; return to duty within 24 hours.

- Immediate -- severe agent exposure, major respiratory problems and vomiting.
- Delayed -- moderate agent exposure, minor respiratory problems and muscle twitching.
- Expectant -- very severe agent exposure, convulsions, collapse and paralysis.

The triage performed by the corpsmen during the initial stages of the amphibious assault is extremely critical since casualties may have longer than normal delays in reaching a medical facility afloat. Once the BAS/ES is established ashore, the major triage function will be carried out there by the medical officer in a more definitive manner.

4.7.4 Battalion aid station/evacuation station.

The BAS/ES is the initial medical support element where the casualty may be seen by a medical officer. It is here that a more comprehensive examination and sorting of casualties is completed, and is it at this location that many casualties will be provided temporary shelter and more definitive care.

The BAS will normally be located forward in the FBH and will be subjected to the same CW threat as the combat and combat support units it is supporting. Personnel of the BAS must be trained and equipped to perform their mission in a contaminated environment. This may be a CW agent vapor hazard of only short duration; a longer term liquid contamination problem, or it may be a hazard presented by a contaminated patient. Whatever the source of the hazard, the BAS personnel must perform their medical support while they themselves are protected from the CW hazard. The BAS personnel will be protected by the NBC ensemble. The addition of CW agent resistant surgical gloves and an improved respiratory protection which imposes mini-

mal degradation would improve the capability of the medical staff at the BAS/ES.

The requirement for mobility and the limited number of personnel available at the BAS preclude any collective protection or definitive decontamination capability. The BAS should have stocks of large decontamination towelettes like those found in the M258A1 kit and some form of dry decontamination mitt or pad to allow additional emergency decontamination of wounds and medical equipment. There is also a requirement for some form of overhead to protect the patients and staff from CW/BW agents.

At the BAS/ES the CW casualty will be treated, as required, with additional CW agent therapy (which is recorded on his medical record) and will be provided assisted ventilation where required. This must be available in the form of an automatic multi-patient resuscitation unit. This will allow pure CW casualties to be detained and stabilized at the BAS while the more critically wounded are evacuated. In some cases, the CW casualty will require continual assisted ventilation throughout his evacuation, while others may improve enough to be evacuated without any respiratory assistance.

When CW casualties are received at the BAS, and also have conventional wounds or illnesses due to other causes, they must be managed so as to minimize the danger resulting from chemical exposure without aggravating other injuries or illnesses. The most frequent problem requiring clinical judgment will be the decision as to which of two or more injuries, wounds, illnesses, or chemical agent insults, will receive priority for treatment and/or evacuation. Cardiopulmonary resuscitation (CPR) problems, measures to control hemorrhage, shock or other clinical conditions resulting from causes other than exposure to a chemical agent may be of equal or greater

urgency than treatment for chemical agent poisoning. All required treatment and care measures may, therefore, have to be performed in rapid sequence by simultaneous action, with life saving measures for a traumatic injury given priority.

The medical officer will be severely limited in his triage, diagnostic, and treatment capability because he will be unable to remove the patient or himself from NBC protective ensemble for examination or treatment while both are in a suspected or confirmed contaminated environment. There is, therefore, an urgent need for the following capabilities at the BAS:

- Vital signs monitor for patient in NBC protective ensembles.
- Administration of fluids and drugs to patients in the NBC protective ensemble in a contaminated environment.
- Low level contamination monitor.

Every effort should be made to select contamination free evacuation routes by reconnaissance and by prompt and accurate reporting and recording of enemy CW agent attacks and resultant contamination. However, during the early stages of the amphibious assault, it is unlikely that the evaucation routes will remain contamination free. Therefore, as the patient is evacuated from the BAS to the next medical facility, he may pass through areas of liquid or vapor contamination. The patient must be evacuated with his NBC protective ensemble intact until he can be placed in some form of collective protection. The personnel of the BAS must insure that the integrity of the patients NBC protection is restored/maintained prior to and during evacuation.

4.7.5 Medical company.

The medical company is established ashore when the tactical situation permits and should be located in a "clean area" at a distance from poten-

tial targets for enemy fire. In selecting a site for the medical company, consideration must be given to locations which will minimize the effects of NBC weapons. Basements or cellars of buildings afford certain protection from conventional attack; however, the concentrations of CW agent would remain higher and longer in such locations. The same applies to forests which retain the CW agent vapors for a longer time. In troughs or low spots in the terrain, so called "gas puddles",* can be found similiar to ground fog, which are especially dangerous because they retain high agent concentrations for prolonged periods of time. Slopes and elevations are thus preferable, although they are, of course, also reached by clouds of nerve gas. The medical company must make compromises in the selection of a favorable site, since terrain that offers cover against the effects of conventional or nuclear weapons is usually much less suitable after attacks with nerve gas, and vice-versa.

The site selected for the medical company should provide sufficient space for dispersion of the decontamination facilities which will be established for incoming patients. In addition, it is desirable to identify a reliable water source (near to the medical company site) to support this decontamination effort.

The medical company must be equipped and trained to provide NBCD measures for its own personnel and equipment as well as perform its mission in a contaminated environment. As part of the unit equipment, there must be decontamination facilities for the medical staff and critical medical equipment and collective protection for the following:

*The term "gas puddles" used in World War I for clouds of gas (usually phoseyene or chlorine) near the ground which did not dissipate for days.

- Medical staff rest and relief
- Patient treatment facilities (OR)
- Patient nursing and recovery facilities
- Critical medical support functions
  - Laboratory
  - X-ray
  - Pharmacy

There must also be provided some form of contamination free storage for medical supplies and equipment which may be in the form of vapor tight containers or some type of agent resistant packaging. In addition to the current unit CW agent detection capability, the agent detection capability of the medical company must be improved to provide the following:

- Low level CW vapor detection
- Patient contamination detection location
- Medical supplies contamination detection
- CW dosimeter for medical staff

When the patient arrives at the medical company, he will be seen briefly at the triage area. The triage area will be under overhead protection, such as a tent fly or perhaps an erected or existing structure. All incoming patients should be considered as contaminated when chemical agents are known or suspected to have been employed in the area. Introduction of a contaminated patient into any collective protection shelter will automatically defeat the treatment capability of the medical company. At the triage area it must be determined whether the patient has a surgical or medical condition which by virtue of its severity assures priority over his decontamination. For example, treatment of severe hemorrhage would have priority over decontamination. The locations to which a casualty may be

directed initially, depending upon the nature of his condition, are the decontamination center (contaminated casualties) or emergency treatment facility (contaminated emergencies) are described below:

- Decontamination center (DC). If a casualty is contaminated with a chemical agent, but is not in need of immediate or emergency treatment, he is first received in the DC. Here all contaminated blankets, clothing, and equipment are removed from the casualty and placed in a dump marked "contaminated", for contaminated material must not be taken beyond this point. The casualty undergoes complete decontamination with soap and water. All patients who are able will decontaminate themselves. Litter patients, and others requiring assistance, will be processed with the necessary assistance. Some form of litter patient decontamination facility is required so that a soap and water bath can be given. After decontamination of the casualty, he is moved to a clean patient holding and processing area (PHPA).
- Emergency treatment facility. When a casualty requires immediate medical or surgical treatment more urgently than decontamination, he is taken directly to this location. After emergency treatment measures are performed, he is then processed through the DC and placed in the PHPA. If the patient then requires additional medical treatment, he will be scheduled in accordance with the severity of his wound.

The medical company will receive casualties from various sources which include the following:

- Untreated casualties from local areas
- Casualties who have received self/buddy aid
- Casualties who have been treated by the corpsman
- Casualties who have been treated at the BAS/ES

Most of these casualties will have had some emergency decontamination and should be fully protected by the NBC protective ensemble. It may be that not all these casualties need to be processed through the DC. However, at the present time, there are no adequate means of confirming the presence or absence of CW contamination. Until such time as a contamination monitor is tested and fielded to meet the needs of the medical service to detect and identify CW contamination, all incoming casualties must be considered to be contaminated. This will impose a significant decontamination workload at the medical company.

Each medical company that is deployed in support of the MAGTF will require a DC. This DC will provide the following services:

- A self decontamination facility for ambulatory patients and medical staff.*
- A decontamination facility for litter patients and patients requiring assistance.*
- Collection and disposal/processing of contaminated clothing and equipment.
- Complete decontamination of patients' protective masks.*
- Complete decontamination of critical medical equipment.
- Partial decontamination of evacuation vehicles when time and patient work loads permit.

*Priority services.

The DC will be established and operated by members of the FSSG H&S battalion NBCD section who must have had special training to perform this type of decontamination mission. (They will require some assistance from medical company personnel). The exact configuration of this DC can only be determined after extensive test and evaluation in the field. The procedures for the DC operation will be initially as described in FM 3-87, appendix B. A type DC, for the medical company, is suggested in table 4-7. After decontamination, patients will be placed in a clean PHPA to await admission into a CP shelter for the treatment necessary to stabilize the patient for either further evacuation or return to duty. Prior to entrance into the main section of the treatement shelter, the patient must pass through the entrance or airlock. The patient will remain in the airlock long enough to allow the air to be purged of any vapor contamination. When the treatment procedures are completed, he will be moved to the PHPA area.

A clean PHPA will be operated by the medical company personnel and will have the capability to provide CP for 10-12 patients when required. Patients will be processed through the PHPA into and out of the patient treatment facility. In the post treatment section of the PHPA, patients will be processed for further disposition. If the patient is to be evacuated further, he will be placed in a patient wrap and have a decontaminated protective mask provided. Every effort will be made to return the patient's own mask to him, as that mask has been adjusted to fit his head and possibly contains his optical inserts. If the patient requires further nursing care, he will be moved to the patient nursing facility. This facility will also be equipped to provide collective protection for the occupants, when required. And, for patients to be returned to duty, clean equipment and NBC protective equipment will be provided. As a general

Table 4-7. Decontamination Center

Personnel

1 Section Leader

2 Decontamination NCOs

7 Decontamination Specialists*

2 Medical Advisors (Corpsman)

Major Decontamination Equipment

1 XM14 Truck Mounted PDDA**

1 Litter Patient Decontamination System

1 XM17 LDS/NBC Sanator

Minor Decontamination Equipment and Supplies

Item listed in appendix B, personnel decontamination station requirements FM 3-87, 22 February, 1980.

*Additional personnel (5-7) from the medical company services section will be required for sustained operations.

**The Navy-Marine Corps shower unit discussed in paragraph 2.5.2, page 2-47, could be tested as an augmentation to the power-driven decontamination apparatus (PDDA).

rule, anytime a patient leaves the medical company, he will be provided some form of individual NBC protection. A schematic representation of the patient flow through the medical company is presented in figure 4-4.

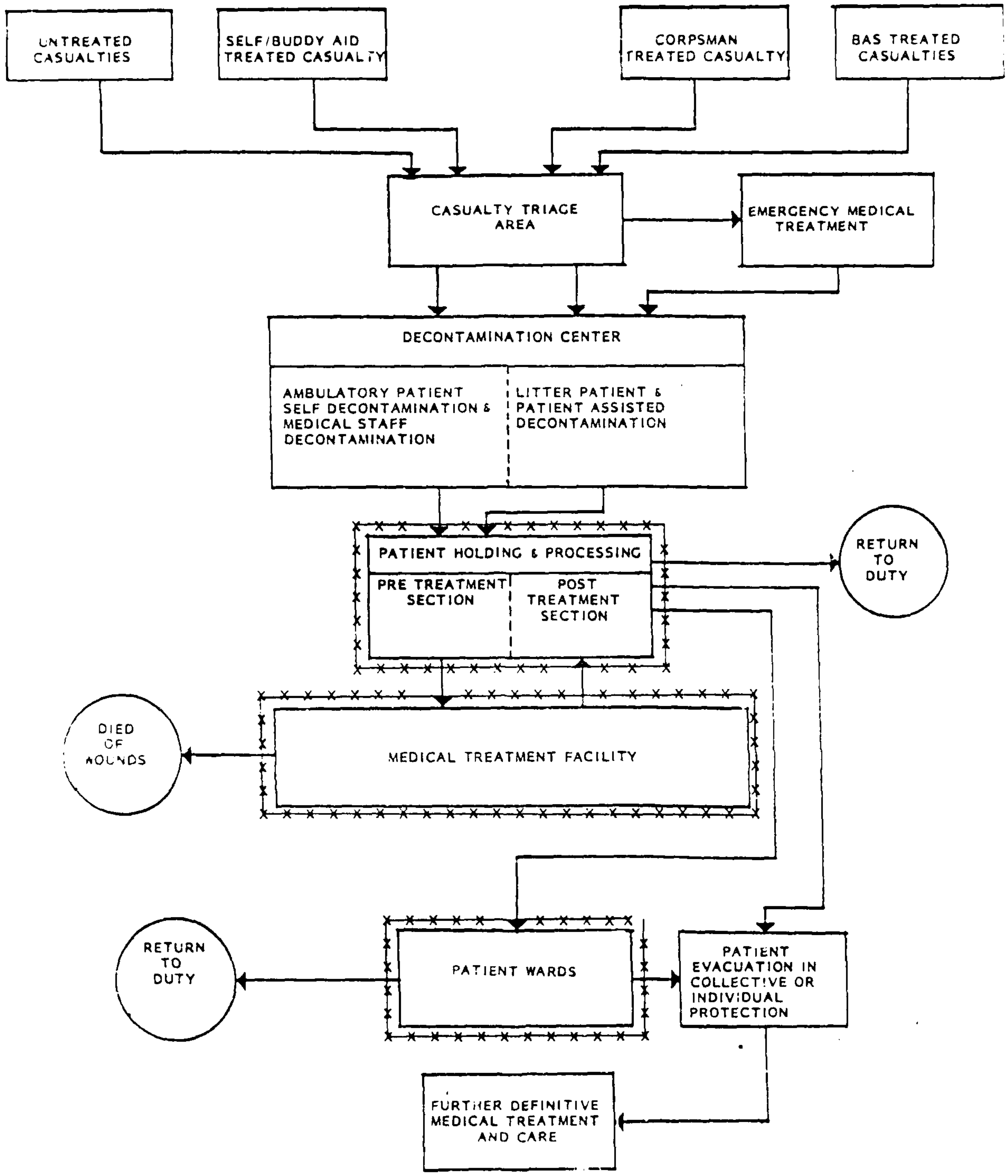
4.6.6 Hospital company.

By the time the hospital company is established ashore, the tactical situation will normally have stabilized. This should present the hospital company with a more predictable and manageable patient workload. Also, at this time, the possibility of a CW attack in the area of the hospital company operations area should be lessened. In spite of this, the site selection for the hospital company should consider the same factors as those for the medical company.

The hospital company, like the medical company, can receive casualties from various sources. However, the majority of its medical workload will be from the medical company. Since patients evacuated from the medical company will be clean (decontaminated) and arrive in the NBC patient wrap, they will present a reduced workload for decontamination. While it will still be necessary to perform patient decontamination at the hospital company, it should be substantially reduced by the proper operation of the DC at the medical company.

The patient flow at the hospital company will be much the same as that for the medical company, and is shown in figure 4-5. The major difference will be the numbers of patients requiring emergency medical treatment prior to decontamination and the number of patients requiring complete decontamination in the DC. The triage area will function the same as in the medical company.

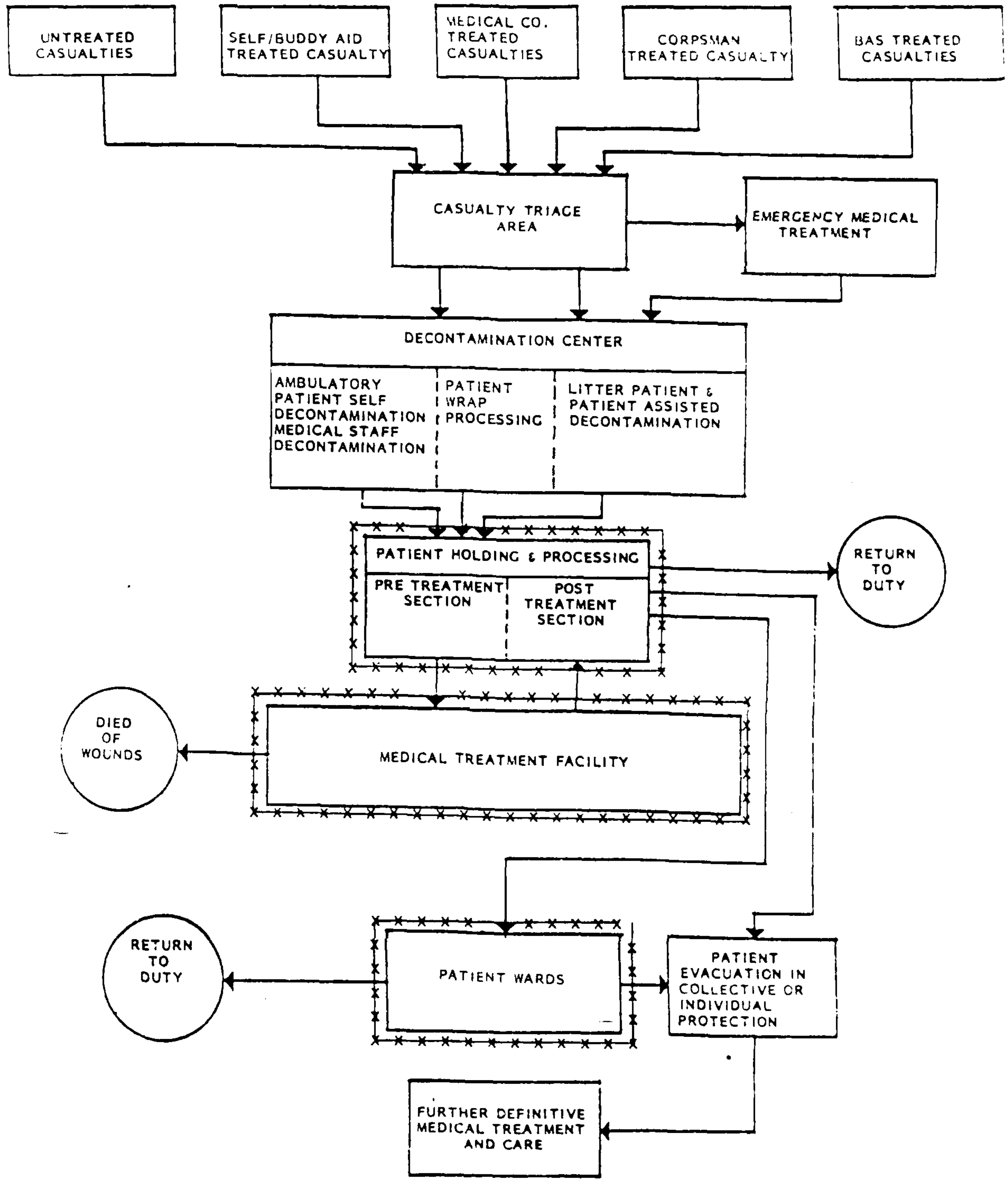
The DC, as recommended in table 4-7, will perform the same functions as those described for the medical company, and one additional function.



Note:

**** Designates collective protection capabilities.

Figure 4-4. Patient Flow in the Medical Company



Note:

**** Designates collective protection capability.

Figure 4-5. Patient Flow in the Hospital Company

Those patients arriving in a patient wrap will be processed through the DC for removal from the wrap and transfer to the PHPA. This is necessary due to the possibility that the patient wrap may have been contaminated during evacuation (this requirement will be eliminated when a contamination monitor is fielded) and cannot be accepted into the PHPA. The PHPA will provide the same service as that of the medical company, but due to the expected patient workload, will be larger, on the order of 20-30 patient capacity.

When the environmental-controlled medical system is fielded, all of the patient treatment facilities and patient wards will have CP. Until such time, if CP is to be provided for the hospital company, it must be the simplified collective protective system discussed in chapter 3, paragraph 3.4.5.1, page 3-40. Due to the reduced CW threat to the hospital company, 3 ORs and 60 beds are considered adequate for CP as an austere interim measure for the hospital company.

Patients being evacuated from the hospital company, both litter and ambulatory, must be provided individual or collective protection until they are admitted to a contamination free facility or are transported out of the CW threat area. This protection can be in one of the following forms:

- Individual NBC protective ensemble.
- Patient wrap and mask.
- Collective protection.
  - Overpressure system in vehicles
  - Ventillated face piece.

In the evacuation of CW patients from the BAS to the medical company and the hospital company, as many as 15 percent of the patients could require assisted ventilation. The multi patient automatic resuscitator

under development (paragraph 4.5.3) can meet this requirement and should be installed in 30 percent of all dedicated medical evacuation vehicles. In addition, the M14 gas particulate filter unit (GPFU) discussed in table 3-5, page 3-29, should be installed in 25 percent of the dedicated medical evacuation vehicles and in 20 percent of the combat vehicles (LVTP7 or its follow-on) used for casualty evacuation in the combat area.

The MAGTF NBC casualty handling system concept is summarized in table 4-8.

4.8 EQUIPMENT REQUIREMENTS

The equipment to support the proposed NBC casualty handling system is listed on table 4-9. Since, currently, there is very little available equipment to fulfill the projected needs as proposed in table 4-9, this table relies heavily on developmental items. The Marine Corps should expedite the testing of these items because, until they can be fielded, the MAGTF medical system will be placed under great stress by the employment of CW weapons by the enemy.

4.9 MASS CASUALTIES IN THE NBC ENVIRONMENT

The NBC casualty handling system proposed in paragraph 4.6 has been designed to provide proper medical care for the predicted workload as presented in paragraph 4.3. This system has not been designed to accommodate mass casualty situations from NBC weapons or other causes. If a mass casualty situation occurs (when casualties suffered, simultaneously, overwhelm all available treatment facilities) as a result of NBC weapons employment the guidelines for mass casualties contained in FMFM 4-5 section 11, page 11-16, appear adequate. However, the following additional information should be included.

Table 4-8. The MAGTF NBC Casualty Handling System Concept

[illegible]	SELF BUDDY AID	LITTER BEARER	HOSPITAL CORPSMAN	BATTALION AID STATION/ EVACUATION STATION	MEDICAL COMPANY & HOSPITAL COMPANY
Triage	None	None	Minimal	Initial	Definitive
Casualty CW Treatment	Administer CW therapy from individual issue Apply contamination resistant wound dressing	Administer CW therapy from individual issue Apply contamination resistant wound dressing	Administer additional CW therapy from medical supplies Apply contamination resistant wound dressing	Administer additional CW therapy from medical stocks Provide assisted ventilation	Administer additional CW therapy Provide assisted ventilation
Casualty Decontamination	Emergency with individual M258A1 and M13 kits	Emergency with individual M258A1 and M13 kits	Emergency with casualties M258A1 and M13 kits	Emergency with casualties M258A1 and M13 kits	Complete at Decontamination Center
Casualty NBC Protection	Individual NBC protective ensemble	Individual NBC protective ensemble	Individual NBC protective ensemble	Individual NBC protective ensemble	Collective protection for: Patient holding and processing Patient treatment Patient nursing
Casualty Evacuation	Contaminated	Contaminated	Contaminated	Contaminated Assisted ventilation Vehicular collective protection	Contamination free in patient wrap or vehicular collective protection
Special Medical/ NBC Capabilities	None	None	None	Vital signs monitor for NBC protection ensembles Contamination free fluid/ drug administration Low level contamination monitor CW resistant surgical gloves Improved respiratory protection with minimal degradation	Decontamination of medical staff and equipment Collective protection for medical staff rest and relief and critical medical support functions Laboratory X-ray Pharmacy Contamination free storage for medical supplies Low level CW vapor detection Patient contamination detection CW dosimeter for medical staff CW resistent surgical gloves Improved respiratory protection with minimal degradation

Table 4-9. Proposed Equipment For NBC Casualty Handling For The MAGTF

EQUIPMENT	BAS/ES	MED CO.	HOSPITAL CO.	DEDICATED EVACUATION VEHICLES
M7A1 GPFU, 6-man	0	0	0	Installed in 25 percent of vehicles
M14 GPFU 6-man		2	6	0
M-12A1 PPDA	0	1	1	0
M-11 Decon				2 per vehicle
Developmental				
Multi-patient resuscitator, 6-man	1	3	10	Installed in 30 percent of vehicles
XM-14 PDDA(1)	0	1	1	0
Litter patient decontamination system	0	1	1	0
XM-17 LDS/NBC Sanator	0	2	3	0
XM-15	0	0	0	1 per 5 vehicles
XM-13(2)	0	0	0	1 per vehicle
Personal equipment decontamination system (PEDS)(3)	0	1	1	0
Navy/Marine Corps shower/laundry N/MCS(3)	0	1	1	0
Simplified collective protection equipment (SCPE)	0	10	16	0
Marine Corps environmental controlled medical system (MCECMS)(4)	0	1 system	1 system	0

Table 4-9. Proposed Equipment For NBC Casualry Handling For the MAGTF (Continued)

EQUIPMENT	BAS/ES	MED CO.	HOSPITAL CO.	DEDICATED EVACUATION VEHICLES
Contamination free patient wrap	0	TBD	TBD	TBD
Low level chemical agent monitor	0	7	15	0
Improved heart rate monitor	1	2	4	0
Blood pressure monitor	1	2	4	0
CW protective bandage	Replacement for current bandage, 1 for 1.			
CW resistant surgical gloves	5 pr	10 pr	5 pr	0
CW dosimeter	1	(5)	(5)	0
Contamination free fluid/drug administration	Replacement for all current fluid/drug IV units, 1 for 1.			
Body fluids micro-processing	0	TBD	TBD	0
Portable electro-static CP system	0	(6)	(6)	0

NOTES:

(1) Replaces the M-12 when available.

(2) Replaces the M-11 when available.

(3) When fielded in combination with the PDDA.

(4) Replaces the M-14 GPFU and SCPE when available.

(5) One per medical staff (TBD).

(6) Possible replacement for M-14 GPFU and SCPE if MCECMS not available.

The mobile medical triage terms (MMTT) must be trained and equipped to perform their mission in complete individual NBC protection.

The mass casualty medical evacuation team should not attempt to provide shelter type CP. They should have multi-patient resuscitators and M7A1 GPFU available for those casualties who require respiratory assistance or protection. The restoration and maintenance of the casualty's individual NBC protection must have a high priority for this team.

The land based emergency standby reception/care facility must have some limited amount of shelter type CP in addition to the M7A1 and multi-patient resuscitator.

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 5

NBCD DOCTRINE AND CONCEPTS REVIEW AND RECOMMENDATIONS

MARINE CORPS REQUIREMENTS AND PROCEDURES

FOR DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 5. NBCD DOCTRINE AND CONCEPTS REVIEW AND RECOMMENDATIONS

5.1 INTRODUCTION

During the conduct of the data collection effort, the study team became aware of a significant report dealing with CW contamination. This report, "Effects of Chemical Attack on Tactical Staging Operations," was published in draft form by Dugway Proving Grounds, Utah, in December 1980 and is referred to throughout this report as the "Dugway Report" or "The Dugway data." The report presented a new method of calculations for CW agent evaporation and CW agent cloud travel and duration. This new method was a significant break with traditional methodology like that incorporated in FMFM 11-3, Employment of Chemical Agents. The study team recognized that this new methodology could have a significant impact on the study and so informed the study advisory committee (SAC) at HQMC.

At the request of the SAC and with the concurrence of the study sponsor, the study team reviewed and analyzed the Dugway data to determine its impact on this study and its possible impact on the recently completed Concept of Operations for NBC Defense in the Midrange[1] study. The initial assessment of the Dugway data can be summarized as follows:

- The new persistence/evaporation model (Dugway) is more useful than the current models.

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[1] Concept of Operations for NBC Defense in the Midrange, Marine Corps Development and Education Command, Quantico, Virginia, 15 June 1981.

- Due to the limited amount of actual test data, both laboratory and field tests, data gaps still exist that limit absolute confidence in all chemical effects analyses.
- The tactical situations presented in the Dugway report are not adequate for USMC requirements.
- Environmental data (weather) used in the Dugway report tactical situations are too restrictive to meet USMC needs.

The major impact of the Dugway data can be seen in the comparison of the Dugway Agent Evaporation Curves (predicted present method) with observed test data obtained from field trials, laboratory experiments, and various other prediction methods. These comparisons are included here as figures 5-1 through 5-4. The figures show that the Dugway data are more closely aligned with the observed data than are the other predicted data, and that there is a significant variation in the evaporation rates. It is these variations that the study team evaluated by use of the CAT. The CW weapons effect data based on the Dugway data was used in a CAT simulation, and then compared with the CAT simulation using FMFM 11-3, and NATO Standardization Agreement (STANAG) 2103, Reporting Nuclear Detonations, Radioactive Fallout, and Chemical and Biological Attacks data. The basic tool for this analysis, the microprocessor-assisted CAT, was developed for the Concept of Operations study. The CAT is a manual wargame with computer assessment of chemical and conventional weapon effects; it provides rapidity and flexibility in investigating the consequences of chemical-weapon employment in continuing a MAGTF operation. The CAT provides data for the investigation of three distinct, but interrelated, aspects of the problem of operations under an NBC threat. These are the frequency and location of chemical strikes, the agent contamination levels, and the movement and duration of contamination on the battlefield.

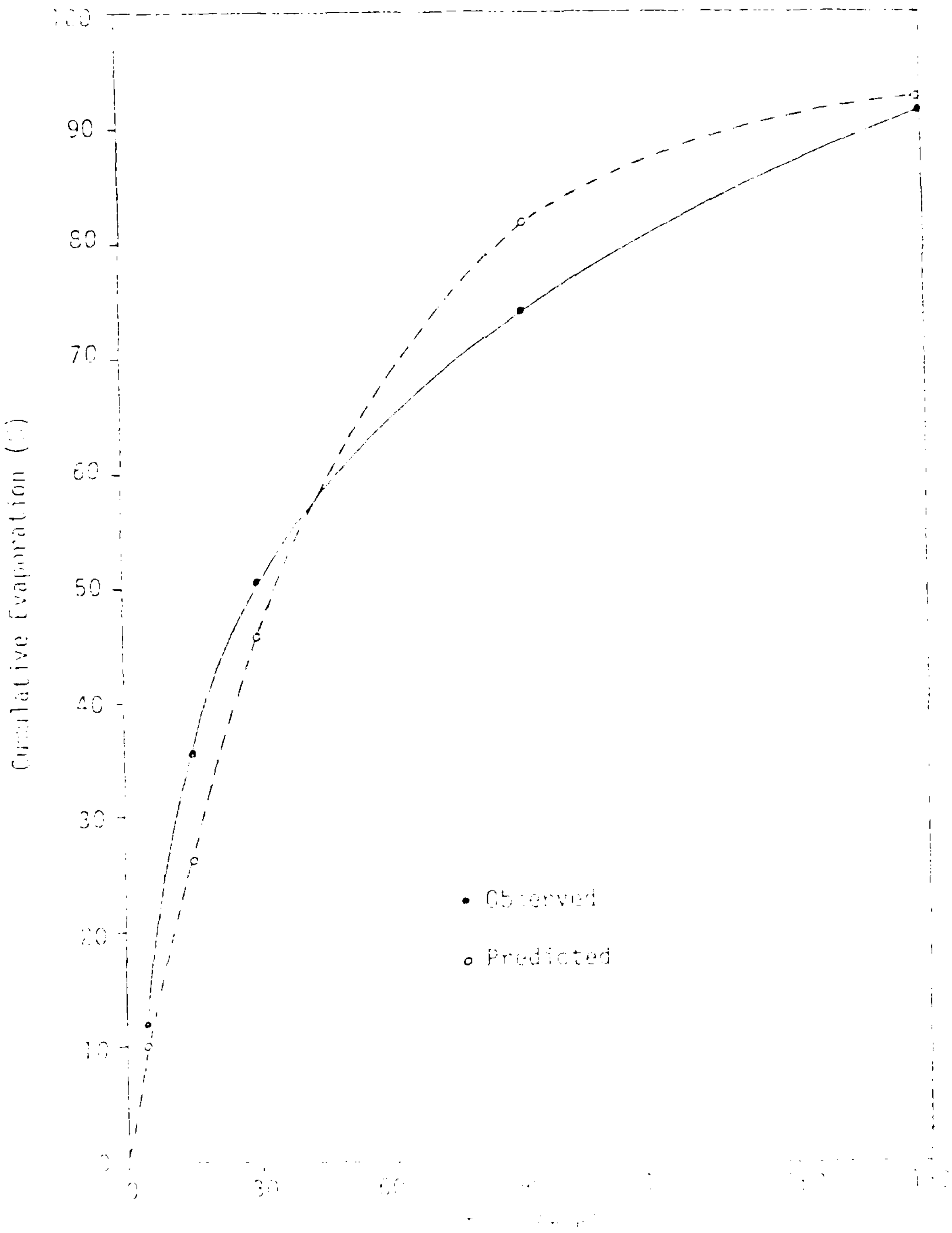

Figure 5-1. Comparison Between Observed and Predicted Evaporation of GD-K125, Suffield Field Trial 2 of FE615

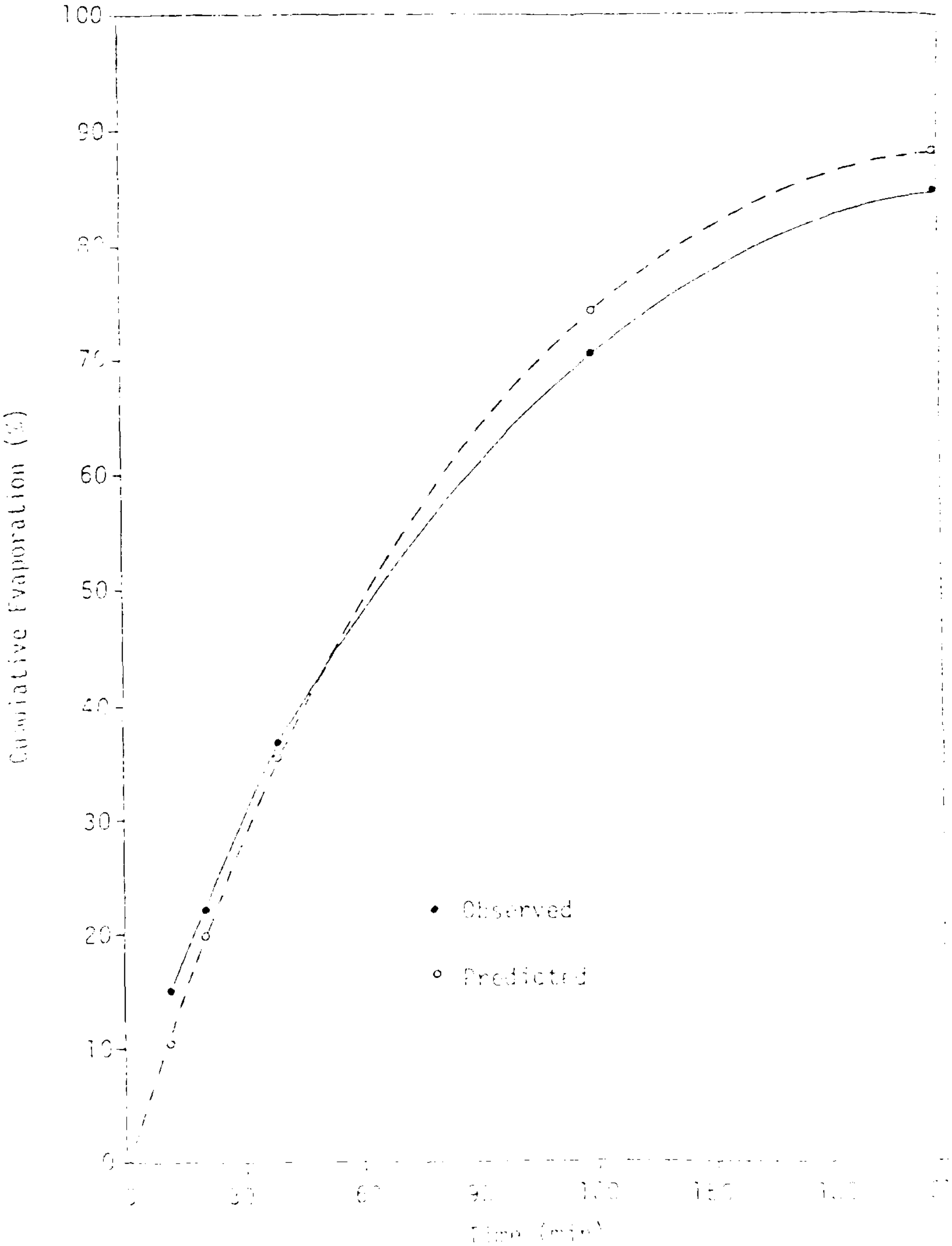

Figure 5-2. Comparison Between Observed and Predicted Evaporation of GD-K125, Suffield Field Trial 3 of FE615

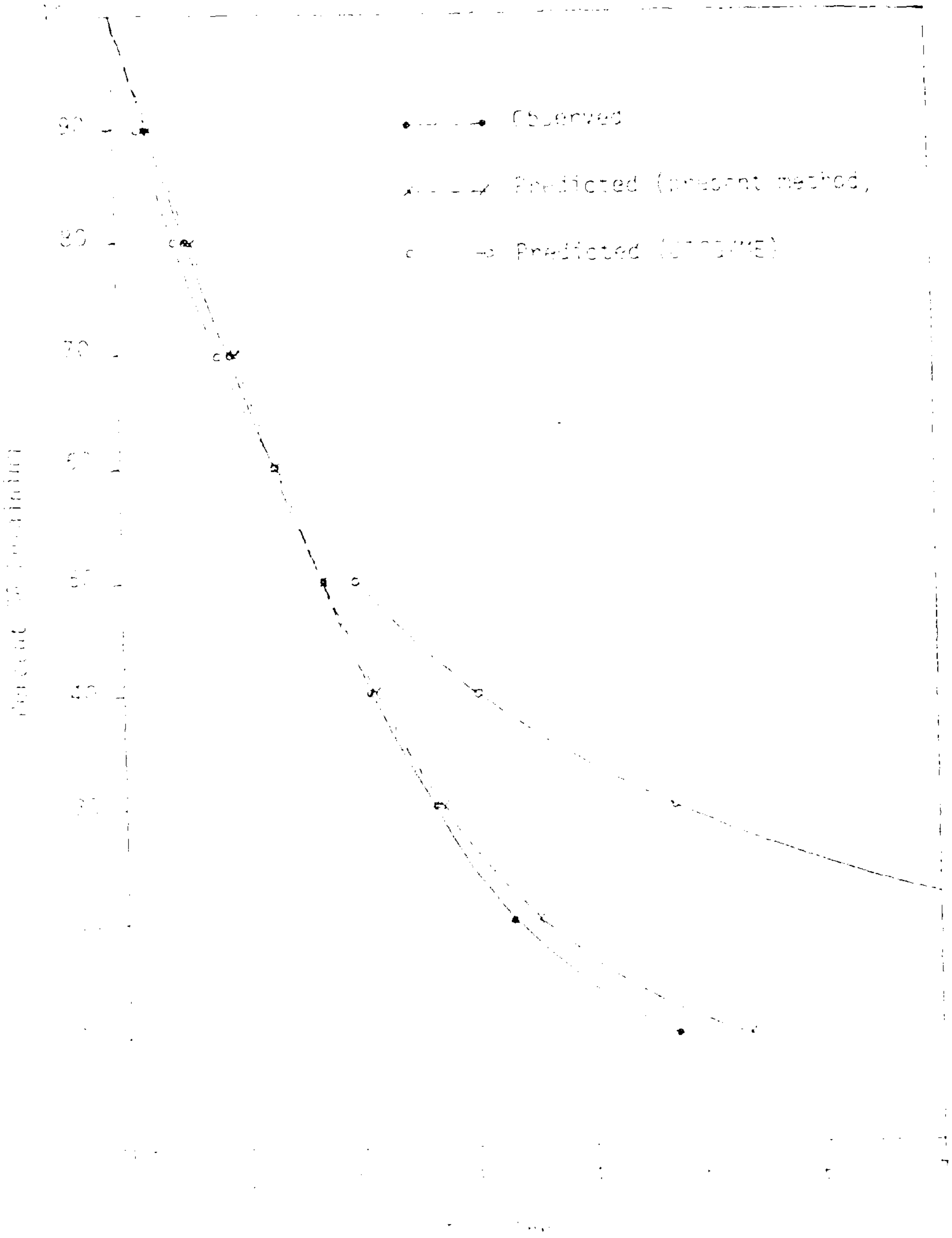

Figure 5-3. Observed Versus Predicted Evaporation of GA - Field Trial

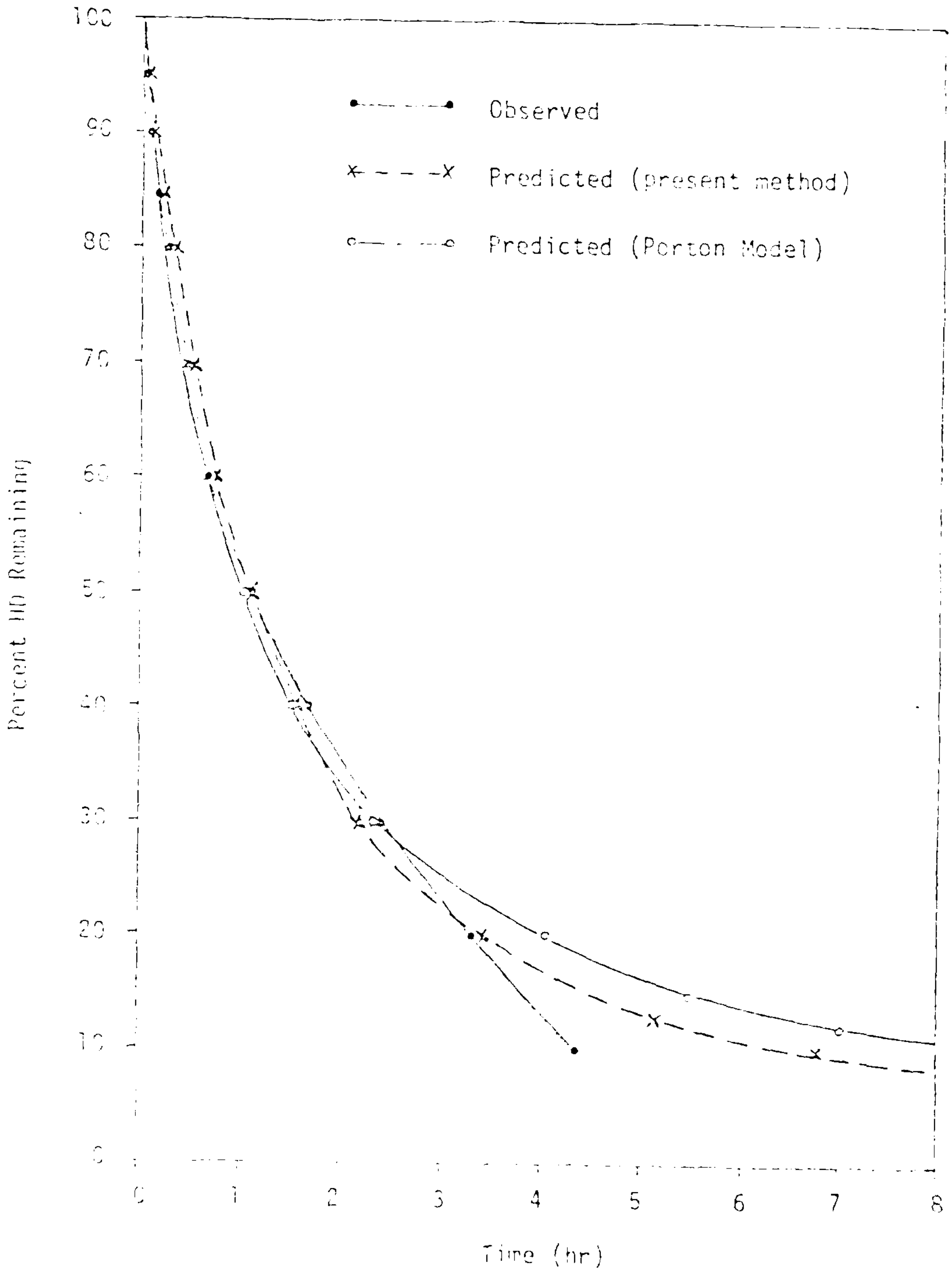

Figure 5-4. Observed Versus Predicted Evaporation of Unthickened Mustard (HD) - Field Trial

It must be remembered that both sets of casualty prediction data used in the CAT are based on an extremely limited open air, live agent test base that does not conclusively substantiate either set of data. However, the study team believes the Dugway data is as valid as any current data available, and as such, offers the Marine Corps commanders options which make mission accomplishment in a chemical environment more easily achievable. The detailed data on weapons effects and casualty rates are discussed in the classified portion of this report, annex A (Volume II).

5.2 IMPACT OF DUGWAY DATA RECOMMENDED FOR NBCD

The casualty estimates which have been developed in our CAT assessment with the Dugway Proving Grounds effects data were in most cases as had been anticipated. The more rapid evaporation of the threat agent reduced the area of off target hazard which in turn reduced the number of exposures to the agent, thus lowering the estimated casualties. Additionally, these Dugway evaporation figures significantly reduce the duration of the hazard, again reducing the number and length of exposures which in turn reduce the expected casualties.

This expected reduction in casualties, while being very significant to the military planner, is by no means the only meaningful use of the Dugway data. The results of the CAT analysis, and a review of the Dugway report indicate several areas of NBCD where the Dugway data may have an impact. In order to identify these areas and evaluate the impact, the study team has selected the functional area of NBCD as presented in previous reports as a vehicle. The study team evaluated the impact on each of the functional areas of NBC defense, and for each of the elements of these NBCD areas as presented in the NBC readiness study. The results of this analysis are presented in table 5-1.

Table 5-1. Impact of Dugway Data Assessments on NBCD Functional Areas

	Doctrine	Organization	Equipment	Training
Detection	●	●	●	●
Identification and Warning	●	●	●	●
Protection	+	●	++	++
Decontamination	++	+	++	++
Medical Aid	+	+	++	++

++ Major Impact
+ Minor Impact
● Insignificant Impact

As a general summary, it appears that the Dugway data will not change or reduce the need for quick, accurate, effective detection, identification and warning, or for effective individual respiratory protection since the initial effects of the threat agents remain the same. There needs to be very close evaluation of the current requirement for whole-body protection (the NBC overgarments, for example) in light of some of the Dugway calculations on agent evaporation. The use of the normal combat uniform as the outer layer of protection might be considered in some tactical situations when the risk is acceptable.

The NBC functional areas that deal with sustained operations in an NBC environment are the most sensitive to the Dugway calculations. The reduction of the duration of the agent hazard as developed in the CAT with the Dugway data causes an impact on requirements for collective protection and decontamination. The problems of contamination avoidance, casualty

handling, and treatment appear to be more manageable in light of these data. These and other areas of NBC defense have been evaluated and reviewed in preparation of this report. The impact of the CAT analysis of the Dugway data, as presented in annex A, has been evaluated and included in the specific recommendations in chapters 2, 3, and 4 of this report. Recommendations, as a result of this evaluation and the contents of chapters 2, 3, and 4, for changes in the doctrine and concepts in the Concept of Operations for NBC Defense in the Midrange[2], Final Report, June 1981 are contained in the remaining paragraphs of this chapter and address the functional areas of NBCD, (detection, identification and warning, protection, decontamination, and medical).

5.3 DOCTRINE CHANGES

The Concept of Operations for NBC Defense in the Midrange study proposed a revised doctrine for NBC defense (NBCD) in chapter 3 that remains valid except for minor changes which are proposed in the following paragraphs.

- Detection. The requirement for detection remains critical to the MAGTF and the doctrine proposed remains valid as previously stated. The use of Dugway data agent evaporation rates does not eliminate the need for rapid detection of agent to prevent initial casualties but reinforces the need for doctrine stressing requirements for and use of detection devices whenever the tactical situation permits.
- Identification and warning. Identification and warning doctrine also do not change, but rapid warning should be stressed after the initial attack. Because of the predicted smaller area of drift

[2]See footnote 1, page 5-1.

of agent hazard, the commander may be able to reduce the area of warning for high mission-oriented protective posture (MOPP). This can only be done if the agent type and level of contamination can be identified accurately.

- Individual protection. The doctrine for protection remains valid. The Dugway data further enforces the commanders risk category of individual protection as the most versatile MOPP level for combat units operating in close proximity to the enemy. It greatly reduces heat stress as a casualty producing factor, and permits combat operations without the degradation associated with encapsulation in protective clothing. The predicted shorter duration of agent hazard will permit quicker reduction of MOPP level. However, this capability requires that a device be developed that rapidly identifies, and quantifies low levels of chemical agent hazard.
- Collective protection. The doctrine for collective protection and protection for combat vehicles proposed in the concept of operations study remains valid. The specific types and numbers listed in chapter 3 are required to support the doctrine.
- Decontamination. The requirement for battalion-sized combat and selected combat support units to perform complete decontamination should be revised. These units normally operate in close proximity to the enemy and would be unable either to provide personnel, or to reduce the tempo of tactical operations enough to establish either EDS or PDS and still accomplish their missions. The Dugway data on P agent contamination persistence, as discussed in annex A,

further confirms the lack of criticality for complete decontamination when these units are operating as part of a larger force. However, in the event these units operate independently or are in static defensive positions, a complete decontamination capability, utilizing a lightweight decontamination system (LDS), may be required. These battalions must have a 6-man team trained, as an additional duty, to perform complete equipment decontamination and provide minimal shower (personnel decontamination) capabilities for such unusual circumstances. Personnel decontamination stations (PDS) would not be required for these units since, generally, they would normally encounter only a vapor hazard. (The U.S. Army has recently recognized this and removed the PDS requirement from the combat and combat support battalions and located them at the brigade level.)

Specific doctrine changes for decontamination are:

- The basic operating standard for survival of an NBC attack; "perform decontamination of personnel in an improvised decontamination station," stated on page 3-43 of the <u>Concept of Operations</u> study, should be revised to read "perform emergency decontamination of personnel and provide, for unusual circumstances, a minimal system for personnel decontamination (shower capability.)" The requirement for these decontamination teams to wear the rubberized protective clothing should be discontinued and the following TAM items should be deleted from the table of equipment.
  - C2030--boots, protective, M2[illegible].
  - C2038--cover, cooling, gas mask hood.

- - C2040--cover, footwear.
  - C2050--coveralls, M3.
  - C2160--gloves, M4.
  - C2230--maintenance kit, protective clothing.
  - C2310--suit, cooling.
- Equipment decontamination stations (EDSs) will be established by NBCD units at the division, wing, FSSG, and other designated combat support and combat service support units.
- Since CSS units are equipment/material intensive and cannot easily move out of contamination, each battalion must be capable of complete decontamination, and have a 6-person decontamination team trained as an additional duty.
- The FMF NBCD organizational structure shown in figure 3-6 of the Concept of Operations study should be replaced with the information shown in table 2-7 of this report to reflect the additional decontamination team requirements proposed. This requirement for an LDS and trained NBCD team seems somewhat excessive in light of some of the threat calculation developed using the Dugway data. However, the relatively low cost/minimal training required to procure and operate the LDS provides the MAGTF units an auxillary decontamination capability for unique situations, which should be acquired.

For reader convenience, figure 3-6 and table 2-7 follow.

LEVEL	MONITOR/ SURVEY TEAMS	DECON TEAMS	CONTROL CENTER TEAM	CONTROL & ASSESSMENT TEAMS	[illegible] TEAMS	NBCD OFFICER MOS 5702	NBCD NCO MOS 57[illegible]	[illegible]	[illegible]	HEAVY [illegible]	NBCD [illegible]	CADRE [illegible]
Company	X					*	**	x	x			
Battalion	X		x	X		*	X					
Regiment	X	X	X	X		X^2	X					
Division			X	X	x	X^2	X			x	X^2	X
Squadron	X	X	X	X		*	X					
Group	X	X				X^2	X					
Wing			X	X	x	X^2	X			x	X^2	X^1
FSSG	X	X	X	X		X^2	X			x	X^2	X^1
MAU						X^2	X^2					
MAB						X^2	X^2					
MAF			X	X		X^2	X					

* 5702 additional duty

**57[illegible] additional duty

[1]Result of this study's findings

[2]Result of NBC Defense Readiness Study and [illegible] action

Figure 3-6 Fleet Marine Force Nuclear, Biological, and Chemical Defense (NBCD) Organizational Structure

Table 2-7 Nuclear, Biological, and Chemical Defense Teams

LEVEL NUDET TEAMS	MONITOR SURVEY TEAMS	DECON TEAMS	CONTROL CENTER TEAM	CONTROL & ASSESS-MENT TEAMS	NUDET TEAMS
Company	X				
Battalion	X	X	X	X	
Regiment	X	X	X	X	
Division	X*	X*	X*	X	X
Squadron	X	X	X	X	
Group	X	X	X	X	
Wing	X*	X*	X*	X	X
FSSG	X*	X*	X*	X	
MAU					
MAB					
MAF					

Note:

*Specialized NBC teams [illegible] provide formally [illegible] required

- Paragraph 3.7.1.4 on page 3-62 of the Concept of Operations study should have added, "Each battalion and squadron will train, as an additional duty, a decontamination team. Battalions with LDS will train 6-man teams while other battalions and squadrons that have the jet exhaust or vehicle mounted decontamination systems will have six persons plus the operators/maintenance personnel for each system assigned." It must be understood that activation of the decontamination team at the combat unit level is not a normal occurrence, but it is the exception since doctrine prescribes that complete decontamination operations occur in relatively clean areas located to the rear of the main battle area.

Medical Aid. The doctrine as presented in the Concepts of Operations study for self/medical aid should be changed to reflect the following:

- Only emergency decontamination will be performed on casualties prior to reaching the medical company.
- The casualties individual NBC protection must be maintained during evacuation as far as the medical company or hospital company.
- Resuscitation will be available at the BAS, medical company and hospital company.
- Self/buddy aid and hospital corpsman aid does not normally include artificial respiration for CW casualties.

Specifically, the following changes are recommended to chapter 3 of the Concept of Operations study.

- Paragraph 3.5.1.8. Treating and Evacuating Casualties, page 3-16. Change "Normally, chemical decontamination will have priority" to "Normally, restoration or maintenance of the casualties individual NBC protection will have priority, and only emergency decontamination will be performed."

- Paragraph 3.6.1.8.3. Chemical/self-aid, page 3-29. Delete "Artificial respiration or resuscitation may be required if an individuals breathing becomes extremely difficult, irregular, or stops."
- Paragraph 3.6.1.9.1. Survival Standards, page 3-31. Change "Performs self-aid and first-aid to include artificial respiration and use--injector" to "Perform self-aid, first-aid and use--injector."
- Paragraph 3.6.2.8.3 Unit Chemical Medical Aid, page 3-48. Delete last paragraph.
- Paragraph 3.6.5.3. Medical Unit Chemical Medical Aid, page 3-56. Change "Chemical contamination of helicopters and crews during aerial medical evacuation will require that the majority of chemical casualties be evacuated by surface means" to "The possibility of chemical contamination on evacuation vehicles requires that all casualties be evacuated in some form of NBC protection--individual or collective."
- Paragraph 3.8.3.2. Specific Individual Training Objectives, page 3-70. Change "Perform proper first-aid to include mouth to mouth---agents" to "Perform proper first-aid while in NBC protective ensemble."

5.4 RECOMMENDED CHANGES FOR MAGIF CONCEPT OF OPERATIONS FOR NBCD

The following recommended changes to the Concept of Operations for NBCD previously proposed in chapters 4 and [illegible] of the Concept of Operations study are based on the analysis of the [illegible] of the [illegible] data, and the recommendations in chapters [illegible] and [illegible] of this report.

- Detection, identification, and warning. The concept of operations for detection, identification, and warning proposed in the Concept of Operations study does not change. However, the need for improved detection and identification devices remains an important factor in how a unit conducts operations. There are requirements for not only a rapid identification device which presents low dose rates, but also for an area detector for advance warning.
- Individual protection. The individual protection concepts remain valid, however, in light of the Dugway data, the discussion of NBC jungle operations in paragraph three, page 4-28 of the Concept of Operations study, should be modified to take into consideration the Dugway data on the effects of contamination, versus the effects of heat stress as a casualty production factor (which are discussed in Volume 2). When troops are attacked with P agents, the casualties experienced by personnel wearing standard clothing and performing decontamination are less than the heat stress casualties experienced when personnel are in MOPP4. Therefore, the short length of time contamination persistence remains a militarily significant hazard reduces the requirement for the length of time personnel must be in MOPP 3 or 4; and reduces the need for extensive personnel decontamination stations (PDS). PDS will be primarily operated by the division, wing, and FSSG NBC units, except in cases of extremely heavy and repeated chemical strikes on isolated units. These reduced contamination levels permit the commander to reduce the MOPP from 4 to 2 sooner than previously stated, thereby, greatly reducing the heat casualties and deterioration of combat

effectiveness formerly experienced. This requires an agent identification/quantification device as previously discussed to be developed and fielded if the maximum capability of the commanders risk concept be achieved.

- Collective protection. The following concepts should be included at the end of <u>page 4-1[illegible] of the Concept of Operations study</u>.
  - Combat units, engaged in the assault within the FBHL, will require a minimum of [illegible]. Because of their proximity to enemy units they will normally be attacked by NP CW agents which will present a short duration hazard. Additionally, the mission of these units, to close with and destroy the enemy, requires a [illegible] degree of mobility which precludes the use of [illegible] systems. Combat units have restricted storage space and limited transportation, which further reduce the availability of CPE, furthermore, offensive combat operations preclude the use of CPE since units cannot pause to occupy a CP shelter. If rest and relief are to be accomplished in a contaminated environment, a unit must be withdrawn from offensive combat operations. If combat units cannot move through or around the contamination and the contamination level is maintained through repeated CW strikes, then the combat units at risk must have the capability of providing [illegible] CP. The primary purpose of CP for combat units is to provide places for rest and relief [illegible] defensive or static situations.
  - Combat support units could be attacked with either NP or P agents [illegible]

close to the FBHL, such as armor, will normally be subject to NP attacks for the same reason mentioned for combat units. Other units such as artillery, armor/assault amphibian units in reserve, and units utilizing communication or radar shelters/vans, would be more likely to be attacked with P agents. There is a requirement that some form of CPE be made available to all combat support units. In particular, communications and radar vans/shelters, in which personnel must operate in a shirt-sleeve environment, must have a CPE system.

•• Combat service support units are usually located closer to each other in the FBH than is desirable for tactical dispersion. The beach areas will present a high density target ideal for P agents. Combat service support units will require CPE for maintenance operations, rest and relief, as well as for C^3 and medical facilities since they have limited mobility and mission considerations may not allow relocation out of contaminated areas. In the early stages of the buildup ashore, support functions will be conducted "around the clock" and, therefore, contamination free environment provided by some form of CP is critical. Rotation of personnel through CP shelters to allow for rest, relief and feeding may become a routine matter for sustained operations in a contaminated area. Sufficient CP must be made available to accommodate this requirement.

•• Wing/squadron operations ashore will require CPE for sustained operations in a contaminated environment. Both

simplified collective protection equipment (SCPE) and modular collective protection equipment (MCPE) will be required as well as modification of existing structures for protection against CB threats.

- Decontamination. The NBCD functional area of decontamination (including contamination avoidance) should be modified to include the additional information on page 420, subparagraph 3 (unit decontamination discussion) of the Concept of Operations study.
  - Combat units, generally will need to only perform emergency, partial, and limited decontamination to survive and continue their mission; however, these units should have a capability to perform complete decontamination should unusual circumstances warrant such operations (for example, independent operations, or certain static defensive situations).
  - Combat support units must have an organic, mobile decontamination system capable of complete decontamination. Armor, and artillery units may not always be able to move out of the contamination or may not be spared from combat support missions long enough to move to a rear area decontamination station. The division and wing NBCD units have trained specialists and specialized equipment to perform complete decontamination operations for contaminated, subordinate, [illegible] support units. The division and [illegible] will provide personnel and earth moving [illegible] created, and NBCD units in [illegible]

- Combat service support units must be capable of emergency, partial, limited and complete decontamination. Specific requirements for equipment to support complete decontamination are dependent on the individual unit's mission. The FSSG headquarters have authorized the NBC specialists and equipment to operate three decontamination teams.
- Marine Corps aviation presents a unique decontamination problem because advance expeditionary airfields (EAFs) will become primary targets for P and M agents. Since few suitable airfields will be located within the AOA, aviation units will be unable to move, once contaminated, and will require complete decontamination capability.
- Aircraft and control squadrons will have one NBC specialist assigned by T/O. These units will train a 6-person decontamination team.
- Marine air base squadrons (MABS) and headquarters and maintenance squadrons (H&MS) will also have an NBC specialist assigned and will train two 6-person decontamination teams.
- The wing engineer (WES) and Marine wing service group headquarters squadrons, will also each have a trained NBC specialist and two decontamination teams. The WES must also provide, upon request, personnel and earth moving heavy equipment for large area decontamination.

A major consideration for aviation should be contamination avoidance actions, such as covering the cockpit area and the intake ducts. If possible, overhead cover should be provided for each aircraft to prevent agent

contamination. The decontamination concepts for fixed-wing aircraft, proposed in the Concept of Operations study, remain valid. Those areas of the aircraft, critical to continuing operations (such as ammunition replenishment accesses, and weapons racks), as well as those areas which require manual dexterity for maintenance operations, must have limited decontamination procedures performed when the airfield is contaminated with P agent. Complete decontamination will occur only when military operations have decreased enough to spare the personnel and resources needed to accomplish the operation.

The requirement for extensive decontamination of helicopters during vertical assault operations, stated in the first paragraph, line seven, page 4-24 of the Concept of Operations study, remains a valid comment for extreme cases of contamination. A more representative statement of contamination, based upon the Dugway data, could be added as follows: Flying will weather the contamination to a militarily insignificant level except for tires, seals, and screw holes. These areas should be monitored for contamination and limited decontamination of critical, mission-essential areas of the aircraft be performed. Complete decontamination will be performed only when the situation allows.

Medical aid. The specific changes recommended for chapter 5 of the Concept of Operations study are as follows:

- Table 5-1, Specific Nuclear, Biological and Chemical Defense (NBCD) Matters for the Planning Phase of Amphibious Operations, page 5-17. Change "Ensure that medical and medical support personnel are trained in mass casualty handling" to "Ensure medical and medical support personnel are trained in handling NBC and mass casualties."

- Table 5-1, page 5-21. Change "Ensure that medical personnel are trained to handle mass NBC casualties" to "Ensure that medical personnel are trained to handle and treat NBC casualties."
- Table 5-5, Specific Nuclear, Biological and Chemical Defense (NBCD) Matters for Assault Phase of Amphibious Operations, page 5-33. Change "Establish aid stations for chemical casualty handling" to "Establish aid stations with the capability to treat and handle NBC casualties."

5.5 SUMMARY

The major impact of the Dugway data on the anlaysis of Marine Corps NBCD operations resulted from the comparison of the Dugway agent evaporation rates with observed test data and various other evaporation prediction methods. The Dugway data are more closely aligned with the observed data than the other predictions and there are significant variations in the evaporation rates.

The study team evaluated these variations and determined that the Dugway data is as valid as any current data available, and as such, offers the Marine Corps commander options which make mission accomplishment in a chemical environment more easily achievable.

It appears that the Dugway data will not change or reduce the need for quick, accurate, effective detection, identification and warning, or for effective individual respiratory protection since the initial effects of threat agents remain the same.

The proposed doctrine changes evolving from this evaluation primarily affected decontamination at the battalion level for combat and certain combat support organizations, and BAS, where PDS and EDS will not be established during normal operations. The battalions will train decontamination

teams, as an additional duty, for unusual circumstances when higher headquarters or combat service support NBC teams could not perform decontamination operations. Collective protection doctrine remains unchanged, with the exception of the BAS where collective protection is not recommended. Chapter 4 of this report provides the doctrine for medical NBC operations, which expanded the limited information in the doctrine presented in the Concept of Operations study.

The majority of changes proposed affect the concept of operations for NBCD. The differences in evaporation rates from the Dugway data resulted in the changes recommended for the concept of operations. Combat and combat support units operating in close proximity to the enemy require a minimum of CPE protection and only for static, defensive positions where units cannot be rotated out of contaminated areas. The shorter length of hazard predicted by the Dugway data further enforces the need for minimal CPE primarily to provide rest and relief for personnel.

Armor, assault amphibian, self-propelled artillery, and other developmental combat vehicles require a CPE system because they are ideal targets for both P and NP agents. Other combat support units, such as artillery and units utilizing communication or radar shelters/vans are also likely to be attacked with P agents.

All of these units must be capable of performing all levels of decontamination operations. Wing and combat service support units require complete decontamination capabilities and CPE must be used for rest and relief, C^3, medical facilities, and certain maintenance functions.

The reduced period of chemical agent persistence provides the Marine Corps commander with the option to reduce his protective posture (MOPP

level) sooner than previously stated, thereby eliminating many heat stress casualties and the deterioration of combat effectiveness normally associated with MOPP4 operations. This advantage requires that a rapid and accurate method of chemical agent detection, identification, and quantification be available. There are urgent requirements for such detectors and monitors. An area scanning detector must be considered another critical requirement which must be satisfied.

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR
DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION

Chapter 6. CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

This chapter provides the major conclusions and recommendations arrived at by the study team. These conclusions and recommendations are a summarized version of the detailed ones developed in each chapter and are presented in the order in which the subject appears in the report for ease of reference. The detailed data to support the conclusions can be found in the appropriate chapter and in volume II. A comprehensive list of resources required to implement the recommendations is provided in each chapter.

6.2 DECONTAMINATION

Conclusions

The introduction of NBC weapons, with their residual contamination potential, into the FBH will cause a significant problem in the FMF. The current Marine Corps doctrine for decontamination is incomplete and not suited to the needs of the FMF. The Marine Corps requires a comprehensive documentation doctrine which is designed to meet the particular problems and limitations associated with amphibious operations.

Recommendations

The Marine Corps publishes (as part of a revised FMFM 11-1) a comprehensive documentation doctrine which includes all the elements discussed in paragraph 2.6 and summarized in table 2-8.

Conclusions

A review of the current TAM indicates that there are inadequate levels and types of decontamination items to fully support and sustain decontamination

operations during amphibious operations. Much of the equipment which is authorized is aging, available in inadequate numbers, and is authorized at the wrong organizational level within the FMF.

Recommendations

The Marine Corps acquire the decontamination items required to implement and support the decontamination system proposed in the preceding recommendation as detailed in table 2-9.

Conclusions

The NBC personnel billets and organization proposed in the Concept of Operations Study, paragraph 3.7, when implemented, will provide adequate resources for decontamination operations. However, the addition of new items of decontamination equipment recommended in the preceding paragraph will require additional maintenance, motor transport and decontamination equipment operators, and some specialized training of these personnel.

Recommendations

The Marine Corps authorizes personnel billets for maintenance, motor transport and decontamination operators required to support the decontamination equipment recommended in the preceding paragraph as detailed in table 2-10. These personnel will be trained as discussed in paragraph 2.7.3 and summarized in table 2-11.

6.3 COLLECTIVE PROTECTION

Conclusion

Based upon the potential NBC threat, MAGTF units will require some form of CP at various times during combat within the FBH and during extended operations ashore. Combat units, engaged in the assault within the FBHL, will require a minimum of CPE. Combat support units will be subjected to persistent agents and therefore will require some form of CPE. Combat service support units will

normally be located in areas that are ideal for persistent agent employment and since they may not be able to relocate will therefore require CPE for maintenance operations, rest and relief, as well as C^3 and medical facilities. In addition, wing/squadron operations ashore will require CPE for sustained operations in a contaminated environment as air operations will be a prime target for persistent agent employment.

Recommendation

The Marine Corps adopted the collective protection system detailed in table 3-14.

Conclusion

The MCESS has no provision for collective protection in its structures. With the threat of NBC contamination in the rear areas there is a need for some form of CP in the MCESS.

Recommendation

MCESS be reviewed and the CP recommended in table 3-11 and 3-12 be considered for implementation.

Conclusion

The MAGTF has a very limited amount CPE, it is aging and in most cases obsolete. There is a need for provision of additional modern CPE for the MAGTF.

Recommendation

The Marine Corps obtain the CPE listed in table 3-15 for the MAGTF.

6.4 NBC CASUALTY HANDLING

Conclusion

Faced with the postulated NBC threat the current medical support for MAGTF is unable to provide an adequate NBC casualty handling capability; it is not equipped nor trained to conduct medical operations in a contaminated environment.

Recommendation

That the NBC casualty handling system concept as developed in this study (summarized in table 4-8) be adopted.

Conclusion

Current NBCD training does not adequately prepare all Marines to perform the tasks that might be necessary to provide self- or buddy-aid or to serve as litter bearers. In addition the hospital corpsman is improperly trained and equipped for operation in a CW environment.

Recommendation

That all FMF Marines be taught the proper actions to provide self- or buddy-aid in a CW environment (as per paragraph 4.7.1) and to function as a litter bearer if needed (as per paragraph 4.7.2). That the hospital corpsman be trained and equipped to perform his necessary functions in a CW environment (as per paragraph 4.7.3).

Conclusion

The BAS/EW, Medical Company, and Hospital Company cannot perform all necessary patient handling functions in a CW environment.

Recommendation

That the BAS/EW, Medical Company, and Hospital Company be provided with the training and equipment necessary to perform satisfactorily in a CW environment. Equipment required is listed in table 4.9.

Conclusion

The medical support system does not have an adequate decontamination capability to process contaminated casualties. There is a requirement for a decontamination element to augment the medical support system in an NBC threat environment.

Recommendation

The Medical Company and the Hospital Company be augmented with a Decontamination Center and described in table 4-7.

6.5 NBC DOCTRINE AND CONCEPTS REVIEW

Conclusions

The critical assumption of the Dugway Report is that a new method of calculations for CW agent evaporation and CW agent travl and duration, described in the report, is a more accurate representation of actual and expected agent behavior than traditional methodology like that incorporated in FMFM 11-3. (paragraph 5.1)

After review and analysis of the Dugway Report, it can be stated that:

- o The new persistence/evaporation model (Dugway data) is more useful than the current or traditional models.
- o The new model provides a better fit to available test data than do traditional models.
- o Due to the limited amount of actual test data, data gaps still exist that limit absolute confidence in all chemical effects analyses. (paragraph 5.1)

Recommendation

That the USMC accept the model and implications of the Dugway Report as an equally acceptable description of chemical agent effects as traditional models, and that they prepare doctrine, organization, equipment, and training for both eventualities.

Conclusion

As compared with traditional models, the more rapid agent evaporation predicted by the Dugway data reduces the area of off-target hazard which, in turn, reduces the number of troops exposed to the agent, thus lowering

the estimated casualties; additionally, the Dugway data significantly reduce the duration of the hazard, reducing both the number and length of exposures, and further reducing estimated casualties. (paragraph 5.2)

Conclusion

The Dugway data, if correct, would impact to suggest doctrinal modification in the protection, decontamination, and medical aid NBCD functional areas. (paragraph 5.2)

Recommendation

That the doctrine and concept changes specified in paragraph 5.4 be considered as equally acceptable descriptions of operations in a CW environment; and that they be incorporated in NBCD activities and publications as such.

MARINE CORPS REQUIREMENTS AND PROCEDURES FOR DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 7

SUMMARY OBSERVATIONS

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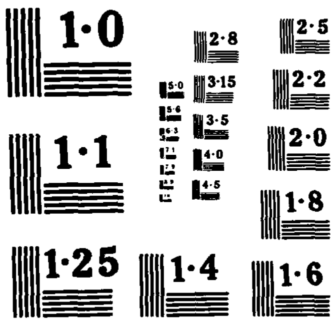

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MICROCOPY RESOLUTION TEST CHART

MARINE REQUIREMENTS AND PROCEDURES FOR

DECONTAMINATION AND COLLECTIVE PROTECTION

CHAPTER 7. SUMMARY OBSERVATIONS

7.1 THREAT PERCEPTION

During the course of this study the study team visited many elements of the Fleet Marine Force (FMF), other U.S. services and allied forces. While each of these may have a different perception of the chemical warfare (CW) threat and they may have established different priorities, one common theme was evident to the study team; the Soviet CW/BW threat is real and probable and there is a critical need for new and improved NBC defensive equipment in the near time to close our window of vulnerability. This outlook was expressed by the Commandant of the Marine Corps, General R. H. Barrow, in the fall of 1981 when he stated as part of his testimony to the House Armed Services Committee:

> "There is a lot of wishful thinking that somehow it's (CW) not going to happen. Perhaps one could say we've had misplaced priorities because we know it is in the Soviet doctrine to use chemical weapons and they have equipped themselves to sustain chemical attack."

The state of the Armed Forces NBC Defensive Equipment was summed up by the former Secretary of Defense Harold Brown, in his annual report to Congress for FY 82 as follows:

> "At the present time, NATO forces lack the capability to defend adequately against the (WARSAW) Pact's chemical threat" and that "warning and protective equipment now in the hands of U.S. forces provide a limited capability to operate effectively in a chemical warfare environment."

To correct these problems and overcome many years of inactivity in the NBC defensive equipment area a massive effort will be required. The Marine Corps must make its unique NBC needs known with force to the research and development community. Several of the developmental items recommended in this report offer considerable improvement to the FMF NBC defensive posture. They must be expedited and acquired for field testing and evaluation by the Marine Corps. These actions must receive highest level of visibility, support, and management if they are to be effective.

7.2 CHEMICAL WEAPONS EFFECTS ANALYSIS

Differences in agent persistence data from two conflicting sources (recent Dugway data versus standard FMFM 11-3 reference data) produce substantially different estimates of chemical effects and contamination on the battlefield. Very persistent and widely spreading nerve agent clouds, as expected from FMFM data, encourage the enemy to use non-persistent nerve agents to generate a maximum vapor threat. Combinations of vapor clouds from adjacent or subsequent strikes create sources of very high casualty risk which the shifting winds, typical of the littoral regions, spread effectively over much of the beachhead area. By contrast, the Dugway data, supporting rapid agent dispersion, suggest that the enemy would use a higher proportion of persistent agents to compensate for minimal agent cloud travel. The battlefield would show much greater risk of liquid agent contamination in target areas, but relatively little risk from vapor cloud drift at distances greater than 1 to 3 km from target areas. If used against well trained and prepared troops, chemical weapons cause casualties primarily because of failures

of NBC protective equipment or procedures. The FMFM data which places a much higher number of friendly units at risk, results in about 2 to 2 1/2 times as many expected chemical casualties, for given enemy resources, as the optimal strike results according to Dugway data.

The difference in data implication from the two sources is of lesser importance to medical support activities for several reasons. Use of chemical weapons, regardless of which effects data are correct, creates sufficient risk of vapor hazard to a medical facility so that, in the absence of completely reliable sensors for zero-risk vapor levels, patient handling (from the corpsmen to the hospital) must presume at least an intermittent vapor hazard. Similarly, liquid agent contamination of patients provides sufficient risk so that, in the absence of reliable contamination level monitors, patients from a chemical battlefield must be presumed to be contaminated. The proportion or distribution of expected casualties by category and by agent symptoms is not appreciably different for the two data sources. The Dugway data would support expectations of only a slightly lower proportion of chemical agent poisoned patients (70 to 75 percent). The maximum number of patients that the medical support system must plan and prepare for depends less on the expected casualty rate for a given expected level of enemy response than it does on a projected casualty rate that could be sustained if the amphibious assault does not proceed as planned, e.g., if enemy resistance is more effective than anticipated. Therefore, the controlling factors for medical support system design are reasonably independent of the dispute over the validity of the two sets of data.

7.3 NAVY MEDICAL SUPPORT PROBLEMS

The acquisition of improved equipment will go a long way toward correcting the serious deficiencies in the NBC casualty handling capability in the MAGTF. However, during the course of this study, a serious fundamental problem was identified which places the credibility of the entire medical support for the MAGTF in question. This problem centers around the Navy policy and capability to receive and process contaminated casualties aboard the casualty receiving and treatment ships (CRTS). At the present time, there is not a collective protection capability within the operating forces of the U.S. Navy. Additionally, there appears to be no established policy with reference to how contaminated casualties will be decontaminated when they arrive at the CRTS for treatment. During discussions with U.S. Navy Bureau of Medicine and Surgery personnel it was suggested that, while not published as policy, the current thinking was the contaminated casualties would not be accepted aboard the "clean" CRTS. It was also suggested that contaminated helicopters would not be landed on "clean" ships. This thinking seems to ignore three very fundamental and likely possibilities.

- The CRTS themselves may be priority targets for CW and could therefore become contaminated.
- There is currently no method of determining if returning aircraft/casualties are contaminated or clean. Once CW has been initiated and an aircraft and casualties have operated in possibly contaminated areas, they must be considered contaminated.

- During the ship-to-shore movement and the early stages of the initial assault, the only medical support ashore is the Navy hospital corpsman. There will be no time, space or personnel resources to accomplish other than emergency decontamination of casualties or, establish a medical holding area to retain casualties until a decontamination capability has been established ashore.

<u>All casualties, contaminated or not, must be evacuated to the CRTS for treatment during the early stages of the amphibious assault</u>. This problem of contaminated casualty handling and collective protection aboard ship must be resolved for the proposed NBC handling system to have any success.

7.4 CHEMICAL WEAPONS EMPLOYMENT

This study, like the two previous NBC studies conducted for MCDEC, has been exclusively defense oriented. This follows the priorities established by the Congress and the Defense Department to build a strong NBC defensive capability into the U.S. Armed Forces. While this goal has not yet been met, action is underway to accomplish it. As part of a balanced deterrent to chemical warfare, NBC defense is only one half of the equation. A credible retaliatory CW capability forms the remaining portion of the deterrent.

The Defense Department has received $23,000,000 for building facilities at Pine Bluff, Arkansas for the production of the binary nerve agent artillery round. This new binary artillery round could be produced in FY 84 if the administration provides funding and obtains congressional approval. The Army is also reported "to be studying the feasibility

of putting chemical warheads on ground-launched cruise missiles of the kind now scheduled to be based in Western Europe," according to recently released congressional testimony.

The cruise missile, with a range of 1,500 miles, is one of a number of weapons being studied as possible carriers of a controversial new generation of binary chemical munitions, according to the testimony."[1]

The Marine Corps will most likely be required to develop munition requirements for the new binary CW weapons to support production planning and funding. The current CW employment data available in USMC publications is inadequate to develop definitive munition requirements. In fact, there is little valid data on CW weapons employment concepts which could support planning for FMF use of CW.

There is an urgent need for detailed plans for the integration of CW into amphibious operations. These plans should be responsive to various tactical scenarios and provide the commander with definitive guidance on target selection, weapon effects, employment criteria, and so forth, similar to that available for tactical nuclear weapons. Current planning fails far short of the detail required to ensure optimal use of these weapons. Once the plans for optimizing the CW munitions have been completed, a comprehensive review of the resupply plans and procedures should be completed, and required changes made in Marine Corps publications to best support the revised CW employment plans for the MAF.

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[1]Washington Post, January 16, 1982.

7.5 NEW THREAT AGENTS

The threat data which has been used in this study was taken from the latest published data available to the study team. This data lists the standard and Soviet threat agents which have remained the same over the last 10-15 years. Most of our NBC defensive equipment has been developed to counter these agents. The recent announcements of the use of toxins known as "yellow rain" as well as other information indicates that the U.S. forces may not have adequate defenses against the full range of possible threat agents. This point was made forcefully in the October 12, 1981 Army Times issue which stated:

> "However, an Army spokesman said the auto-injectors issued to troops as a self-treatment aid against nerve agents would not work against the "yellow rain" powder that has been seen dropped from Soviet helicopters and fixed-wing AN-2 and AN-12 aircraft.
>
> 'We know very little about this stuff,' said the official, 'and so far we have no antidote for it.'"

Other reports from Southeast Asia contain information on bizarre symptoms, not usually associated with the known CW agents, being reported following various mysterious "smoke bombs" air attacks.

It would appear that the Soviets have some new, modified or improved CW agents in their arsenal. We cannot safely assume that our detection and warning devices will respond to all possible threat agents nor that we have the proper treatment for the full range of threat agents. Therefore, there must be an intensive intelligence effort to identify any new threat agents. Finally, the fielding of high quality, individual NBC protective equipment must be the focal point of continuing research and development

in the future. The individuals capability to survive and continue his mission still depends on this training with and proper care and use of this individual NBC protective ensemble.

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